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Farmers' Institute Bulletin

ISSUED JULY 1, 1904.

CONTAINING

Addresses Delivered

AT

Farmers' Institutes

W. W. OGILVIE,
Commissioner.

Held Under the Auspices of
Department of Agriculture
State of Tennessee.

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Preface

WHEN I assumed the office of Commissioner of Agriculture, I determined to push the Farmers' Institute movement that had been inaugurated by Major T. F. P. Allison during his administration, and had continued to grow in favor with the farmers through the administrations of his successors. During the past year sixty-nine Farmers' Institutes have been held in a like number of counties under the auspices of the Department of Agriculture. In most of the counties the attendance was very gratifying, and the information derived from these meetings is now being applied by many farmers in Tennessee with profit. I have been very greatly impressed with the interest manifested by the farmers throughout the State in these Institutes, and believe they have accomplished a great deal of good. I now propose to issue this hand-book to the farmers of Tennessee, containing the addresses of the men who have helped to make the Farmers' Institutes a success, so that the valuable information they have given at the various meetings may be preserved in permanent form and kept as a text-book for future reference, a copy of which can be had free upon application at this office.

W. W. OGILVIE,
Commissioner of Agriculture.

LIVE STOCK AND QUARANTINE.

By R. A. Kittrell,

State Live Stock Commissioner.

WHILE the subject of Live Stock is wide in its scope, and important in its bearing, I shall not endeavor to review in detail the work of our improving breeders. Their enterprise and perseverance, their systematic methods, call forth the highest praise. And never in the history of any successful breeder has form been sacrificed, or individuality forgotten; it was the keystone of the arch on which the paper pedigree was built. Where do we get our inspiration for any line of work? From whom do we get our pattern or ideal? From the product of our improving breeder, and from the intense practical ideas of our best buyers we can draw many a lesson. We need not grope in darkness and doubt, making slow and tedious development of light, if we will only avail ourselves of the life history of these, and experience of those who have succeeded. This is an age of progress, and we should profit by each other's experience. If there is anything good and profitable in us, let us share it with one another.

Among the many agricultural subjects and pursuits that occupy the minds and time of our farmers, I know of none more interesting, or profitable, than that of animal industry. And when the fact is considered that our hills are being rapidly stripped of their timber, and much of our once productive land is being washed and worn from continuous cultivation, we should at once begin to correct this evil by getting these worn fields and waste places in grass, and give more attention to raising Live Stock.

Who of you cannot recall to mind a farm in your locality that has been wisely planned, and is being successfully operated for such an industry? An ideal stock farm, with substantial improvements, with permanent pastures, well fenced, and generously supplied with water and shade, is a rich heritage for any man. And yet it is possible for any young man with health and energy and frugal economy to become the happy owner of just such a place. Hundreds of boys have gone out from parent's charge without education or money, and made wonderful strides in farming, stock raising, merchandising, and banking; not by accident, but it was the legitimate result of a determined effort and a persistent practical study of the line of work they had in hand.

What these have done, others can and are doing. And since this is such an inviting and attractive industry, and considering, too, the fact that we have within our State such varied soils, and the widest possible range of climatic conditions, favorable to the production and development of as great variety of animals, we should make a careful study of this important problem, and endeavor to unite conditions of soil and climate and methods of feed and treatment as best suits each particular breed, and thereby be enabled to produce animals of all breeds with equal merit to that of any State or locality.

The best individual horses, cattle, sheep, and swine, in fact, the highest types of all breeds, are the product of environment, consequently more prepotent and capable of transmitting characteristics to offspring. One of the well-springs of our prosperity rises in our export trade, and among its branches our animal products form no mean proportion. Twenty-five years ago we had scarcely shipped a bullock across the Atlantic, and now we realize more than

$30,000,000 annually from our live beef exports; while for both live and dressed meat, it reaches the enormous sum of $200,000,000. We should invite and encourage this trade by a better system of production and development of our domestic animals. This growing demand, together with that of our own rapidly increasing population, make this industry a very fertile field, boundless in its size, and ready to be cultivated. It is a mine from which we can dig more gold than all the real mines combined.

The first cattle we have any account of in this country were brought in with the first Dutch settlers in New York in the seventeenth century; later Sweeden, Denmark and the British Isles furished their quota to their sons and daughters here. These cattle were imported for the practical purposes of work and food; the question of breed did not enter very largely into the consideration. From such mixed ancestry our so-called native cattle sprang into existence, and not until the nineteenth century had far advanced did improvement in this industry begin. And about the year 1835, Shorthorns were imported in considerable numbers and distributed in Ohio and Kentucky, which States have produced many historic herds. Some years later the Herefords and Aberdeen Angus breeds were imported from England, and other breeds soon followed. The importation of Shorthorns, however, exceeded in number that of all others combined; then begun the study of adaptability. The remarkable demand from the range country gave a great stimulus to that industry. The hardy, thrifty characteristics of the Herefords, their adaptability to the range conditions, have established their reputation, and the most notable purchase of these cattle for the past few years have gone to Texas and the Northern ranges. The pre-eminence of the Angus cattle as feeders and on the butchers' block is the result of careful breeding and good management. Their characteristics fit them for the climate of Iowa and Illinois. They do not possess the rustling qualifications necessary for success on the open ranges.

There are other breeds of cattle worthy of consideration; and while all possess a high degree of merit, I am constrained to believe all are the product of environment, and hence we should study the habits and characteristics of the various breeds, and choose that which best suits our locality and our conditions. Steers of any of these breeds, however, will attain to the weight of from 1,000 to 1,200 pounds, with the average facilities offered by this state; while the same cattle will attain to the weight of from 1,400 to 1,600 pounds under all the conditions favorable to their development. However, I do not think it necessary that you should get a pure bred or registered herd in order to get the best results. In fact, I doubt the wisdom of such an outlay of money to the average farmer, but what you want is to grade up your native herds with a cross of some pure breed, which cross should be determined by the rules and conditions to which I have already alluded.

We might get a valuable lesson from Texas along this line. Her native cattle were a coarse, narrow-hipped, heavy-horned breed, undesirable feeders, and low-grade butchers; and while our people have allowed their herds to deteriorate, Texas breeders have met the issue. They saw the faults in their cattle and started to remedy them by crossing on their herds our best Herefords and Shorthorns, thereby adopting our model individuality and preserving all the hardy characteristics of their native breeds.

When a large number of good feeders are wanted, where do the buyers go? To Texas, Wyoming, and Colorado, because in those States can always be found material that tops the market. It seems to be the universal disposition of our people to buy when everything is high, and to sell when low, and during the depression in cattle in the early 90's the depletion of our pure bred, even good grade cattle, was distressing, while our Western neighbors were drawing on our best herds to build up and improve theirs to make ready for the reaction which was sure to follow. And as a result they have been reaping a rich reward for their care and patience. In numbers and value of cattle, Texas leads the van.

The ultimate purpose of cattle is beef and butter; and in our struggles to succeed we must meet the issue. We must give more consideration to conditions and adaptibility, and less to fads and fashions. It matters not whether you have a Duchess or Cruikshank family of Shorthorns; or Anxiety, or Wilton of the Hereford; or Blackbird of the Aberdeen Angus; neither does it matter whether it is Red Roan or Black, so it is best adapted to your conditions and better meets your requirements. Cattle from the rich pastures of Illinois will not meet the requirements of the Western ranchmen, neither will they suit our mountain and bottom ranges. All cattle and all grasses are not indigenious to the same climate and soil; neither is type confined to any class of cattle, but it goes further, reaching localities and meeting distinct issues in all parts of the State. These are subjects to be considered if we would succeed in cattle growing.

Horses and mules will always occupy a prominent and important branch of our animal industry, and I am glad to see an increased demand, and at higher prices for better quality, but whether much benefit will accrue to the farmers of Tennessee from this source depends very much upon your system of getting at the work you have in hand. There is often too much pedigree for the individual. What is pedigree? It is often a sweet morsel for the expert to roll off his tongue when showing you the animal. Pedigree is the claim of long descent. Dictionary defines it "lineage," but in the animal kingdom it means the way to uniformity; and while it is not my purpose to minimize the value of a pedigree, I do insist that in selecting any animal for any purpose, whatever that individuality, general conformation be your first consideration; next, pedigree. These two qualifications combined insures prepotency. Practical purpose and utility should be considered in all lines of breeding. These rules should be observed, not only in cattle and horses, but in sheep and swine as well. As in cattle and horses, there are also many breeds of hogs, all claiming superiority, which superiority, of course, depends on locality, climatic and other conditions. We can breed a lazy, thriftless hog, one that will, at a great expense, attain to an enormous size; or we can, by a judicious combination of blood strains and a true conception of adaptability, produce a hog that will greatly help to economize in his development.

But not unlike all other industries, there are many issues to meet and difficulties to overcome. Diseases, both contagious and infectious, often hinder the progress of our animal industry, and while neither time nor knowledge will allow me to review all the diseases to which our domestic animals are subject, yet I wish to briefly discuss that communicable disease konwn as "Texas fever" or "Splenetic fever." This fatal disease, after long years of experimental investigation, has been proven to be communicable from one animal to another through the agency of a particular parasite, known as the Texas fever tick.

These investigations also prove both disease and ticks to be of Southern origin, and about the first known account we have of Splenetic fever dates back three-fourths of a century, when cattle from South Carolina were prohibited by the people of Virginia from being driven through that State. It was ascertained that these Southern cattle affected the cattle with which they came in contact, while they themselves remained in perfect health. Very little more was heard about this disease until about 1850, when Texas cattle began to be driven through Arkansas, Missouri, and Kansas for distribution as feeders in those and other Western States, when a mysterious and fatal disease appeared along the highways and trails over which these cattle were driven, destroying a very large per cent of the native cattle; this continued until the year 1861, when the conviction that Texas cattle disseminated the disease became so strong that laws were enacted by Missouri, Kansas, Illinois, and Kentucky regulating the movment of Southern cattle. This ceased in those States during the Civil War, and appeared again with the first droves of cattle from Texas after the war to Illinois, Ohio, Indiana and other States to be fed, and when the warm weather set in fever broke out wherever Southern cattle had been. The excitement aroused by this epidemic led to extensive investigation by the United States Department of Agriculture, and by the Boards of Health of those States.

This investigation developed the fact that this infection had already invaded half of Virginia and North Carolina, and all of Georgia, Florida, Mississippi, Alabama, Louisiana, Arkansas, and large portions of Tennessee, Indian Territory, and Texas. Yet science had still failed to reveal the secret of this infection. So investigation and experiments continued, and about the year 1879, experiment by inoculation was made, and it demonstrated the fact that blood taken from the vein of a Southern cow, or bovine, and injected into the vein of a Northern, would induce fever. With this clew the experiment continued until 1889, when it was ascertained, first, that Northern cattle pastured in the field with Southern cattle infected with ticks would contract fever; second, that Northern cattle pastured in the field with Southern cattle that had been carefully freed from ticks by hand picking did not contract fever; third, that ticks picked from Southern cattle and spread upon pastures were means of communicating disease.

Since it has been ascertained that ticks are the agents through which this contagion is transmitted, the question is how do they convey it? We learn by a study of the life history of these contaminated parasites that they do not migrate from one animal to another. When once fastened upon an animal they remain until grown, then drop off on the ground, deposit their eggs and die. There is no possible chance for them to carry blood from Southern to Northern cattle. Scientfic investigation, however, has revealed the fact that the blood of Southern immune cattle contained the contagion of Splenetic fever, and that this contagion is a protozon organism analagous to the parasite of human malaria, and is in some manner transmitted from the adult tick through its egg to its progeny, and this offspring has the power to transmit it into the circulating blood of the animal on which it chances to fasten itself. These ticks are sometimes borne on the bodies of other animals than cattle, in which event ticks would become noninfected and lose the power to transmit disease until infected with the blood of Southern cattle. These ticks, however, go through the same process of procreation that other ticks do, and the newly hatched parasites will crawl upon cattle that chance to come along. Then what? Should it chance to be Southern cattle, which is not only possible but very probable, then these ticks would become infected and very dangerous. And whether infected or noninfected, cattle bearing such ticks on their bodies would be subject to quarantine, and would not be allowed to be removed except as provided for Southern or ticky cattle. No explanation or certificate of health would pass such cattle without restriction. Hence it behooves us to awake to the seriousness of our real condition, and our interest in this matter means much to the cattle industry of the State. Through carelessness, or indifference, we have allowed this infection to invade our territory, and it has spread and extended until many counties are involved, causing great loss, not only to the counties infested, but damaging and hindering the commercial value of the entire State's cattle product. According to statistics furnished by the United States Department of Agriculture, the total value of Tennessee cattle, January 1, 1903, was $12,000,000, and it is estimated that $3,000,000 would be a fair proportional value for the cattle in infested counties, considering territory, and allowing 15 per cent loss on this sum incurred on acount of quarantine and inconvenience and shrinkage in holding for open season, amounts to $450,000 annual loss. How long will we tolerate such conditions? Where is the remedy? Surely it is not in complaining and revolting at what seems unfair and burdensome restrictions, but by faithfully observing all the rules and regulations for the detection and suppression of those parasites we may hope for better conditions.

Let me urge the appointment, or election, by the several County Courts of an active, competent Live Stock Inspector, whose duty it shall be to detect and suppress communicable diseases among domestic animals, to prevent the running at large of diseased or infected animals, to quarantine all infected premises, and advise owners to destroy ticks, which can be effectually done by the application of any mild or bland oil over bodies of cattle once a week for a few weeks.

And I trust that you will become interested in this matter to the extent that you use your hearty co-operation and influence in the support of every law and rule that offers protection to the health and development of Tennessee's animal industry.

BERMUDA GRASS.

By W. Gettys, McMinn County.

BERMUDA GRASS is a native of the West Indies, and does not mature seed in the United States. It loves a warm. porous soil, but will grow on any upland in Tennessee that is suitable for the other grasses, except that it will not do well in the shade. It comes late in the spring and fails under the first heavy, killing frosts in the fall; therefore it does not furnish an early or late pasture like Orchard or Blue Grass, but it has no equal among the grasses for mid-summer grazing, withstanding the most severe droughts when clover and other grasses have failed.

BERMUDA HAY.

For hay it is not equal to clover or the other domestic grasses in Tennessee, either in quantity or quality, although it has yielded for me, in two cuttings, two tons of dry hay per acre, on good upland, and the live stock relished it fairly well. I have measured individual stalks or stems of it that were from four to six feet tall, but in this latitude and soil it usually grows only from eight to twenty-four inches high, yet the stand is so dense on the land that the yield of hay is surprisingly large.

FOR BARN YARDS AND LIVE STOCK PADDOCKS.

Nothing equals a Bermuda sod for barn yards and large paddocks when the ground is rolling and so liable to wash Such grounds have held for me an unbroken sod for fifteen years. Even mule lots—if well set—will remain intact, if they are somewhat protected from the trodding during the wet seasons, and also during the freezing and thawing weather in winter.

BERMUDA FOR HILLSIDE PASTURES.

No grass of any kind will furnish as much grazing for live stock, or protect so well the land from washing at all seasons of the year, as Bermuda. It luxurates under the warm sunshine and showers of spring; it mocks at droughts of summer, and revels in the parching sun when every other grass droops and dies.

Aside from a few counties, where Blue Grass is indigenous and to which the soil is esepcially adapted, there can be no such thing in Tennessee as a permanent pasture, except by the use of Bermuda Grass. All other pastures grow thin, "threadbare," and become filthy with noxious stuff in the course of four or five years. These Bermuda pastures may be turned every few years, and a good crop of corn raised on the land, and when the work is done and the summer is ended, the Bermuda will be found as thick or thicker than ever, with a new hitch on life. I have raised on such lands as many as forty bushels of corn per acre, and after cutting the corn in the fall, found the grass covering the field like a carpet. It laughs and grows fat at the sight of a negro and a mule and their one-horse corn crop.

HILLSIDE DRAINS.

On nearly every upland field in this country there are natural outlets for the surface water which falls during the rainy seasons. In time, these, if unprotected, will become deep, ugly gulleys, an eyesore and nuisance. Good farmers sometimes go to heavy expense in flooring these natural drains with flat stones to carry off the surface water and prevent washing, when a Bermuda sod would have cost but little, answered the purpose better, and more than paid the expense of putting it there in the grazing it furnished.

A WARNING.

Like many other useful things in this world, Bermuda is not an unmixed blessing. Beware of allowing it to get about your garden or orchard, or other places where it can't be killed out by some kind of smothering crops. Wherever heavy crops of peas, sorghum, etc., can be successfully grown in succession, this grass can be eradicated.

ITS PROPAGATION.

In putting down large areas to Bermuda it would be desirable to sow the seed, which may be done in March or April, either alone or with oats, if after a trial in a small way it is found to succeed in your soil and climate. The seed can be bought from any of the Southern seed houses for about 40 cents per pound, using two pounds of clean seed per acre, along with other grasses. Prepare the ground well, cover lightly or roll the land after sowing, or, if freshly worked, do not cover at all, but depend on the spring rains to do the work. It is slow in starting from seed, and wants a clean bed in its early growth so its elbows will touch the bare ground and take root. If other grasses get the start of it, this will be prevented and the Bermuda will spread slowly. However, up to the present time I have heard of no very successful efforts in securing a good stand by sowing seed.

ROOT CUTTINGS.

The best sods have been secured by root cuttings. An old sod is dug or plowed up and cut to pieces with a heavy disc harrow or run through an ordinary feed cutter, and then sown broadcast, or planted in narrow rows, alone or with oats, and plowed in. This may be done in March, April or May, and sometimes later if the season is favorable. My own method has been to plant it in the furrow with corn, hauling a wagon load of the roots to the field at corn-planting time, and letting a man or boy follow the corn planter with a basket and drop the roots in the furrow about three feet apart, then follow with covering device. In this way no crop is lost for the season. The summer cultivation of the corn will do the Bermuda good, and the clean "middle" will furnish a bed across which the roots will creep and will, if the soil is good, almost cover the whole surface by fall. After cutting the corn, harrow in a crop of small grain and sow other grasses. Allow the field to run for pasture or hay three or four years, then plow up in spring and sow oats, or put in some kind of early maturing corn. Cultivate the ground like you expected a good crop of corn, and you will probably get it, and along with it an everlasting Bermuda sod. If no old sod can be found in your neighborhood send elsewhere for enough roots to set a small spot of good ground on the farm, after which you will always have your own nursery, which will furnish a permanent supply for planting large areas.

The foregoing suggestions on the culture of Bermuda Grass in Tennessee are made to the farmer who is well-to-do enough to own some kind of live stock. The man too poor for that is too poor to own and cultivate a hillside farm. The persistent efforts of the past generation to grow in succession corn, wheat, and oats on such lands, without stable manure, is a perversion of the use to which these lands are adapted, and as a result they stand today with their faces scarred and gaulded, pleading for food and rest. The generation before us cleared the valleys and uplands, and now we are climbing the crest of the hills and robbing them of their belts of timber, which once attracted passing summer showers and held in check the floods of winter and spring. The truth is, that much of the past management of our lands in Tennessee has been a crime, and, as it is with other kinds of crime, knowledge and repentance have come rather late.

The young man who owns fertile uplands should be impressed with the fact that fertility of soil, like a good character, when once lost is lost forever. The land may be patched by manure and other restoratives until it will yield good crops, but it cannot be wholly restored to its original fertility and value. Ten acres of land that the Creator made good in the beginning, and that has been kept so, are of more value than a quarter section that man has impoverished and then tried to make over. It is not claimed that Bermuda Grass is a panacea for all the ills of the hillside farmer, but if a good sod is secured it will last forever, hold the soil better, and furnish more grazing for live stock than any other grass known to this latitude.

HOGS---Management, Care, Etc.

By H. C. Wilson, of Crockett County.

Mr. President, Ladies and Gentlemen of the Institute:

IF there is any apology due for my continued presence before this Institute on this subject, I guess our worthy Commissioner and large and handsome President should make it. For after mature and conscientious consideration, they surely considered your humble servant the leanest hog in the herd; therefore being able to tell something in regard to how a herd should be managed in order to not keep them lean. These conclusions were, without doubt, correct so far as leanness is concerned, but the latter part of their consideration is open for discussion.

This is a big subject—in fact, the biggest that the farmer has to deal with, and it should have a big man to handle it before this intelligent body of farmers.

Hogs are the mortgage lifters of the farm. They pay the school bills, build fences, barns, dwellings, and put the piano in the parlor, and get us in touch with our city cousins through the telephone, and pay for the letter-box before your gate. They do this by converting your grain, clover, grass and lots of refuse stuff into gold, in a much shorter time than any other kind of live stock on the farm.

In this paper it is useless to go into a lengthy discussion as to why the pure-bred hog is better than the scrub, for I am sure there is not a man in the audience who will say that the scrub is even to be considered in a talk on Profitable Hog Raising. So when we say "Hogs, Management, Care, etc.," we mean a hog that will get there, and make his owner a profit on food consumed and care bestowed. The scrub once held a place in our country's agriculture, but the time has long since passed, and he is as much out of place today as the scythe blade in a Sacremento Valley wheat field. He is a relic of the past, cast into oblivion by the progressive ideas, the brains and "stick-to-it-'iveness" of the greatest and most honored class of men in God's creation—farmers.

The first consideration in hog raising is the proper selection of breeding animals; some people think because a hog has a pedgree, pure blood coursing through his veins, that he is all right, regardless of his individuality. They think just so the blood is there, that is sufficient; that the offspring will be as good as from any. This is a mistake. It is an immutable law of nature to revert back, to deteriorate, and it takes the best efforts of man, the deepest thought into the science of animal breeding to build up and improve the forms of animals and increase their capacity for assimilation of food. Hence the selection of hogs for breeders plays a most important part in hog raising. There is nothing too good for the farmer. He should have the best of everything suitable to his purpose, and, in the case of hogs, it is simply a part of good business management, and if you will only think for a moment you cannot afford to use anything but the best for your purpose.

There is a difference in farmers raising hogs to be sold for breeding purposes and the show ring, and those raising porkers. A pig that will win in the show ring is not always the best pig for the general farmer to buy; and when he goes to a breeder to buy, he should choose the pig most suitable for his purpose, regardless of price. Twenty dollars looks a whole lot bigger than $5, but in most cases a pig costing $20 will be more profitable than one costing

$5. The difference is based on actual pig, and not fancy points.

And right here will be a good place to say something in regard to the errors a good many people fall into in buying breeding animals. I breed Poland Chinas, so am better posted on the kicks made concerning that breed. At our International, State and County Fairs, each year, are brought together thousands of hogs to compete for honors, and in order to more accurately judge the animals there has been proposed a scale of points, dividing the hog into about twenty parts, varying a little with the different swine associations of all breeds of swine. The Southwestern P. C. Record Association gives nineteen parts, with the following number of points for each part; one hundred points being perfect: Head and face, 4; eyes, 2; ears, 2; neck, 2; jowl, 2; shoulders, 6; chest, 12; back and loins, 15; sides and rib, 8; belly and flank, 6; ham, 10; feet and legs, 10; tail, 1; coat, 2; color, 2; size, 5; action and style, 4; condition, 4; disposition, 3.

You can readily see from this that the largest number of points are placed on the most important and valuable parts. There is a detailed description accompanying this scale of points, describing just how each of these different parts should be to secure their full number of points. There is also a list of objections and a few disqualifications. Now, it is all right for a farmer, and he should acquaint himself with these different parts of a hog and familiarize himself with the value placed on the most important parts, so he may be able to intelligently select animals for breeders and feeders; but the trouble is with quite a lot of farmers who buy hogs, they put the most value on some parts that does not amount to a hill of beans, such as the ear, for instance. In my experience in selling hogs, by far the most common error, in my judgment, is made concerning the ear. People who are not familiar with the origin of the Poland China breed seem to think that a Poland China, to be pure bred, must have an ear that comes straight from the head, and one-half to one inch from the end tip gracefully over. This is a beautiful ear and one that is sought for by most breeders who show hogs, but it is hard to get, and a very small per cent of Poland Chinas have them. In fact, Poland China ears come in all styles, from an upright Berk's ear to a large, flabby, thick one, that almost covers the entire face. Either of these latter ones are objectionable in the eyes of a fancy breeder, but should cut no figure with the farmer who raises pork for the market or home consumption.

But, generally, the ear is the first part of the hog noticed when buying, and if it is a nice, little, tippy ear, they are caught regardless of heart girth, buck ham, spring of ribs, and feet and legs, and some fellows utterly refuse to buy an extra good pig, just because the ear is not fancy. Now, the ear counts two points in the show ring. In the market it would likely bring two cents; at home, in the kitchen, the children might "scrap" two minutes over who should eat it, after the "gude" housewife had spent two hours in dressing it, declaring she wished hogs did not have any ears at all.

Still two-thirds of the farmers, buying Poland China hogs, will turn down a No. 1 good animal because it has not a pair of those valuable little tippy ears. Gentlemen, this is a mistake, as I have said before. Poland China ears come in various shapes, and will continue to do so for many years to come, and probably for all time. Why, it is a fact that some breeders who make the rounds of the shows each year "for revenue only" keep their show hog's ears done up in curling papers for months prior to the season, so they will have the proper and correct tip. Now, do you think that the offspring from these animals would inherit the tippy ear from their prize winning parents. Not much.

Another common error is in color; a white spot the size of your hand has been the means of many a man losing a good animal. Color counts two in showing, and the farmer throws the hair to the north wind when he kills hogs, and the packer does not know the spot is there, but it counts wonders when buying for breeders by a fellow who has gone "daffy" on color.

Another error is the coat. Some Poland Chinas have straight hair, some wavy, and some curly; nearly every one wants the straight. That is the most desirable from point of looks, but counts nothing in value of meat, and it is poor economy for the farmer to pay $5 more for a pig with straight hair than for a curly one, equally as good in other respects. Another is the tail. If a Poland China or Berkshire has not a white switch on his tail he is not full-blooded in the eyes of some. Another is in size. Lots of farmers think because a pure-bred hog is the best kind of hog to raise it should be a monstrosity, and if he does not tip the scales at 100 at ninety days he is no good, or at least not the one to buy. Another mistake, gentlemen, I think.

The big hog at the County Fair used to be the topic for conversation weeks after, and a good many people in this twentieth century yet think the big, coarse, ugly, long-maturing hog is the most profitable, but carefully conducted experiments and the experience of investigating farmers, breeders and feeders, show conclusively that the medium-sized animals give the most satsfactory results, both as breeders and feeders; and again, some buyers will not buy a pig unless it weighs a round 100 at ninety days old and 200 at six months old, and so on. Now, these weights can be obtained, but it is rare, and if you have a pig shipped you of any breed, weighing anywhere from forty to sixty pounds at three months old, do not kick or say that fellow has put off a runt on you. Some of the greatest prize winners weighed no more at that age. All breeders are striving to get a large hog at a small age, other qualities not sacrificed, but this very much desirable quality is not obtained in a day nor a year, as it can only be done by proper selection, care, food and management. With this object in view all the good qualities a hog should have to make perfection will never be gotten. So let the farmer insist on the best for his purpose when buying, but do not go daffy on fancy points that count "nit" for market or smokehouse hogs.

Now, gentlemen, I mention these objections, by buyers of Poland Chinas, only because, as I said before, I am better posted on this breed. The other breeds—Berkshires, Durocs, Chesters, Tamworths, Yorkshires, Thin Rinds, etc., are subject to similar errors by buyers of these breeds. It is always some minor point that amounts to nothing, so far as meat production is concerned, that causes the trouble between buyer and seller.

So much for hogs in general. Now, for management, care, etc. After making a good selection of breeding animals, do not think the trick is done; it has only begun, for remember it takes a clover field, rape and rye patch, succulent grasses, corn crib, and roller mill cross to get a profitable hog, and with this cross and without shelter and proper sanitary precautions, you are still out of the way of profitable results. Success or failure, in the business of manufacturing the raw materials of the farm into savory bacon and luscious hams, depends now on the proper care and management of your herd.

Some people, I think I am safe in saying most people, in our section of the country think the sow and her son can make out with less attention and care than any other kind of their farm animals. They will stable, rub, and feed the best they have in the barn to an old scrub cow that will make 100 pounds of butter in a year, worth $10, and curry, rub, fondle and feed on sweetmeats, twelve months in the year, a Texas pony, just to get to ride over to Trenton the first Monday, and let a sow that brings eight or nine pigs twice a year, worth, with a little more feed than you give them, $150 (the sow not counted in) lay in a manure pile for a bed and rustle a straw sack for breakfast. Why, bless your life, brother, the old sow and her family of sons and daughters bring you more money for the feed consumed, and in the shortest time, than any other kind of stock you have on the place, and why in the name of common sense a Tennessee farmer does not fall in love with his herd of hogs, like he does with his dog, is a mystery to me. Some people say a hog has no intelligence, he is a hog, and that is all; wallows in the mud like some men, and is not worth any affection, attention or kind treatment; that he is too low down in the scale of animal kingdom to bestow any kindness on; that he would not know or appreciate it anyway. I am by that kind of a fellow "like the fellow who lost his apples out of the end gate of his wagon going up hill," I can't do him justice.

And to you, brother breeders, who are trying to produce a hog fit for our brother farmers to buy, if you think you can ever accomplish anything in the breeding business that will give you a reputation for "good deeds done" without falling in love with your hogs, you are sadly mistaken, in my judgment. You have got to go among them, get acquainted with them to understand their grunts of satisfaction, or disapproval, to know their wants and needs and supply them as far as it is in your power to do so. In fact, you have to get as fond of them as the old fellow over in Scotland was of his cow and calf, or the old bachelor in England was of his cattle. Both stories told by Hon. Robert Bruce in a Thanksgiving toast, "The Stock Breeder and his Work," for *Breeder's Gazette,* 1903.

Scotch John, of Abberdeenshire, was on his death bed, and being far from a lawyer, called in the parish minister to write his will. Having noted all that John said, the question was asked: "Now, John, are you sure you have included everything?" "Yes, everything." Mrs. John, who was standing near, said: "You have forgotten the big cow and calf." "Hoots, woman," said John, "I can't part with them, I'll just keep them to meself." The old English bachelor had built up a fine herd of cattle. Mr. Beatty, a famous breeder, heard of these cattle and went to see them, determined to bring some of them away with him. After inspecting them in the yard, his quick eye singled out five which he meant to purchase. Turning to the owner he said, "Tell me the price of the five cows," giving the names he had noted. The old fellow's answer came quick, "God bless me, man, do you think I could part with my cattle in that wholesale way?" and turning fled to the house. Beatty only got two, and had to use the diplomatic abilities of a Panama minister, aided by the old fellow's sister, to get them. These two cows were as good as ever left the shores of Britain, so said Mr. Beatty, afterwards.

These are extreme cases, but from similar men come the great sires and dams in all pure-bred animals. Well, you are no doubt saying: Why do you not tell us how to manage and care for our hogs so as to get the best results, you are not giving us a detailed account of how this should be done. I am not going to try. I might go on and give my ideas and method, which have panned out fairly well with a small herd, but circumstances may not be the same with you, and my methods might, or might not be the best for you. There are a few general principles applicable to all, and I will say, study the needs and wants of your herd and supply them as near as possible. Get it into your cranium that they will pay you handsome dividends if you give them handsome care and close attention. Give them all they want of grass, clover, rape, rye, and any kind of green stuff. They relish plenty of room for exercise, shade in summer, shelter in winter, good clean water and plenty of it, keep the lice off them, and their sleeping quarters clean and disinfected. Keep salt and ashes where they can have access to them at all times, make the ration ample, and as varied as possible, with enough corn to balance it up, and at the finishing period stuff all the corn into them they will eat, and I believe you will have a fair margin of profit made in the pork business.

I might take up this subject from a breeder's standpoint and give my ideas of how he should mate his hogs for best results; how to treat the sow from time of breeding until farrowing; how she should be fed after farrowing, and what would be best for the pigs, their feed, how to cull them, how to sell them, and the relation of breeder to farmer, and so on and on; and, taking the feeder's side of the question, air my views on the best way to feed and manage them up to the marketing.

The vast amount of pork, bacon, and hams we yearly send abroad from the United States, and how little of that amount Tennessee furnishes, and how well adapted is Tennessee to making cheap pork and the best breeders (right here will say that best Poland China boar, under twelve months and over six of age, exhibited at International last week, came from Tennessee). Last year at some show a Tennessee Berk took first in his class. This year I have not seen report on Berks.

I might take up all the different phases of the hog industry on the farm, but it would take up too much of the Institute's time, and I could not tell it in an intertaining and instructive style, anyway, so I will desist. Now, I will be glad to hear you all talk hog for a few minutes. This is an important subject to the farmers of West Tennessee, and if we do not sell much meat, it is very important to raise what we consume at home as cheaply and economically as possible, and an exchange of ideas will help us all.

Heretofore, in this Institute, I have gotten up, said my little say, one or two fellows up in the gallery would stamp their feet a time or two, I would sit down, and the hog deal was closed. Now, I would like to have some discussion on this subect, if it be only a little bout between some Berk admirer and Duroc breeder. I am not much on answering questions, and by no means am I a walking encyclopedia on hogology, and am a right smart timid before an audience, but if anyone wishes to ask questions about hogs I will try to answer, and if I cannot some one else can.

HORTICULTURE.

By Horace Rainey, of Maury County.

AT the request of our Commissioner of Agriculture, I will tell you of my successes and failures in fruit growing.

When quite a boy I had an abiding faith that I could make money growing fruit, so when I got home from college in 1872, I at once went into the business, recklessly and with great enthusiasm.

There lived in our town a fruit tree agent in whom I had great confidence. I believed everything he said and followed his advice strictly. I did not know fruit tree agents then as well as I know them now. I planted largely of apples, peaches, pears and grapes.

I will first tell you of my failures. My first planting of peaches was an orchard of about six acres. The Hales Early was the earliest variety then known, and I planted largely of it.

My friend, the agent, said it was never known not to have a good crop. So I planted and cared for my young orchard with the same tender affection a mother would bestow upon her infant, and as the land was good I was rewarded with a vigorous growth. About the third year, all conditions being exceedingly favorable, I had a fairly good crop of fruit, ranging from one dozen to a peck to the tree, and on the 27th of May I took the first to market. It being exceedingly early for peaches, and the first fruit of the season, I had no difficulty in selling them at 50 cents a peck. I realized a snug little sum from my young orchard. I was greatly elated and enthused, and it took but little calculation to figure out a fortune in growing peaches; for, with good railroad facilities, I had the whole world for a market. The following spring I planted thirty acres in Hales Early.

The second season my young orchard did not bloom. What was the matter? I could find no cause for it; neither could any one tell me. The following year there were but few blooms, and of course but few peaches. (I did not know then that the peach crop could be killed during the winter.)

The next year the trees bloomed abundantly, so abundant that each tree seemed a bank of blossoms. I have seldom seen such a large crop of fruit of any kind as was on those trees. There were too many, the trees would break down, and the fruit would be small; more than half of them must come off, and to avoid injuring the trees and the remaining fruit they must be taken off by hand, and at once. This was accomplished at the end of ten days and at heavy expense, but the remaining peaches grew and developed so rapidly that I felt well paid. I was sure of a big crop, of big prices, and a big bank account.

I bought a supply of crates and baskets and step ladders, built sheds in the orchard under which to pack them, took a trip to Louisville and Cincinnati to get acquainted with the commission merchants, secured express rates, got other things in shape so that all hands could devote their whole time to the peaches.

About the time the peaches begun to ripen it begun to rain, and for many days if it was not raining it was damp and cloudy. The peaches begun to rot, and they rotted faster than they ripened. I begun to ship the best of them, they arrived in market in bad condition, and instead of a check I would receive a telegram, saying: "Don't ship rotten peaches, no market for them."

I lost my whole crop. I did not get $1 where I expected $100. I found out after many years of strenuous effort, and after spending large amounts of money and energy, that I could not grow peaches profitably, simply because I did not live in a peach country.

While I was struggling with my peaches my Bartlett pear orchard was coming to the front. My first crop sold for $4 per barrel; the next two crops I sold in the orchard at $2.75 and $3 per barrel. There was big money in Bartlett pears, so I increased my orchard several thousand trees.

I discovered a few dead branches in the orchard, and others would seem to wither and die in a day. The following year the dead branches were so numerous as to become alarming. I did not know what was the matter, and as no one could tell me, I wrote to the Pomological Department at Washington, and explained the case and asked for the cause and remedy.

Answer came promptly saying it was the Pear Blight, and the only remedy was to at once cut out and burn all affected branches, which would check the disease, and while doing so, I cut out all other branches that might be in the way, not knowing that every cut I made on a healthy branch with the same knife inoculated that branch, so, instead of checking the disease I was only spreading it, with the result that the next season every tree was affected, and my whole orchard was ruined.

I failed to grow grapes profitably on account of the Black Rot. By a system of bagging, and by persistent and judicious spraying they can be grown fairly well, but not so as to compete in market with more favored locations. So I abandoned the culture of grapes as a business, leaving only a few vines for family use.

About the time I planted peaches and pears I planted ten acres in apples. My dear friend, the agent, advised me to plant twenty varieties; one-third of them summer, one-third fall, and one-third winter. He said no variety would bear a crop every year, and that when one kind failed another might not, so by having many kinds I could safely calculate on some every year. This advice is good, provided the varieties are suited to the soil and locality. I found out ten years later that of the twenty kinds only two were profitable to grow, or was suited to my soil and locality. It took me just ten years to find out what my friend, the agent, should have known and should have told me.

I will take this occasion to suggest to my brother fruit growers that, inasmuch as the United States Government has expended a large amount of money to find out just what varieties are suited to every locality and every soil in the country, and that as this information will be given to any one for the asking, that a law should be enacted making it a severe penalty for a nursery, or an agent for any nursery, to sell trees or plants not suited to the locality for which they are intended.

This want of the adaptability of the variety to the soil and locality has done more to injure the fruit interest than most any one thing. The planter doesn't know, and the nurseryman either doesn't know or won't tell him, and the result is a failure. There is no excuse for the nurseryman not to know, and he should be made to tell or take the consequences.

However, the two varieties, the Wine Sap and Ben Davis, saved me from a thorough disgust with the fruit business, and I was encouraged to plant them largely, having now more than one hundred acres of them alone, and I find them quite profitable, and can recommend them for this or any other section in which they are suited.

Having long since abandoned the attempt to grow peaches, pears and grapes, and having devoted myself almost exclusively to growing apples, I will proceed in detail to tell you how I plant, prune, cultivate, gather and store this "king of all fruits."

There are but few farms on which there is not some place better suited for the orchard than another. Select always the highest land, and any good corn land will grow apples, and if the land is too poor the trees will be stunted; they will live but a few years and the fruit will be small; and if you have it too rich there will be an excess of wood growth and but little fruit. Avoid extremes either way.

In planting, remember you cannot prepare the land too well. A deep plowing, followed by the disc, and then the smoothing harrow is good. With a big plow lay off thirty feet, north and south, throwing the dirt both ways, then with a lighter plow mark off east and west twenty-five feet, and at the crossing of the rows you will find the hole nearly big enough; a few shovels full of dirt removed will generally be sufficient. Cut off all bruised or diseased roots with a sharp knife and straighten out the remaining roots in their natural position. Sift in fine dirt among the roots, and when well covered, tramp firmly and continue until the hole is full. The tree should not be planted deeper than it grew in the nursery.

I wish to say a few words in regard to the condition the trees are generally in when received by the planter. Most nurserymen, in order to facilitate the packing and shipping of their trees during the winter and spring, strip the leaves off early in the fall before the leaves and young wood are matured. The trees are then dug and "healed in," as they term it. This "healing in" is placing hundreds of trees in a long trench as close as they can be put; the roots are covered with dirt until wanted. These trees are sold, generally, by agents. Some are delivered in the fall, some during the winter, but most of them in the spring. They are taken from this trench, remain in the sun or drying winds during the slow process of packing, are shipped sometimes hundreds of miles, unpacked and delivered to the farmer by the agent. They are again exposed to sun and wind and again "healed in" until wanted, and are taken up again and exposed for some time before they are finally set out.

This manner of handling trees is very convenient to the nurseryman and his agents, but it is done at the expense of the farmer. Let us look at it from a common sense view, and let us reason a little.

Night is intended for the animal kingdom to rest and recuperate from the day of labor and activity, and during these hours of inactivity the rest is unbroken and comfortable. The winter months is the season of rest for all vegetable life.

The young tree, during the summer and fall, grows as nature intended it should; its foliage and limbs and buds are matured, the leaves, when their full maturity is reached and their natural functions are performed, drop to the ground, and the young wood on which they grew is ripened and ready for the severity of the winter. When spring opens, after a season of long, healthful, undisturbed rest, it leaps into life and begins another season of active, healthy growth.

Now, compare this healthy young tree with one stripped of its leaves before they, or the young wood on which they grew, are matured, the roots ruthlessly torn from the earth, broken and mutilated, crowded in a ditch with hundreds of others, taken up and shipped or hauled long distances, again crowded in a ditch, again taken up and then set out and exposed many times to the sun and winds. The one rests naturally, and when spring comes its vitality is perfect; the other has had its rest disturbed, its vitality is low, and if it lives at all it makes but a feeble growth. In most cases the bark on the roots will be found dead or diseased. I had rather pay two prices for a tree left until spring where nature placed it, than to have as a gift one stripped of its leaves and "healed in" over winter. One will make a good healthy growth the first year, while the other will make a feeble, sickly growth. It is within the power of the farmer to get either of these two classes of trees from the nurseryman. If he demands his trees left in the nursery row it will be done, but if he says nothing the "healed in" class will be put upon him. I never plant a tree until after the first of March. I always buy them in the fall on condition that they are not dug until they are ordered and to be shipped immediately afterwards.

The roots of the trees when received by the farmer are generally mutilated, and as the nurseryman sends it just as it grew, severe pruning is necessary in order to equalize matters. After many years of experience I find that I can grow a better tree, have a greater per cent of them to live, have a more evenly balanced tree, with the main branches more evenly distributed, by cutting off the entire top, leaving only a straight stem about 3½ feet high. Early in the season young shoots will appear all over this stem, from the ground up, and when about two inches long I break off all but just enough at the top to form the head, generally from three to five, taking care to have them as evenly distributed as possible, for they are to form the main branches of the tree. All other shoots are kept broken off for several years, thereby forcing the whole substance of the tree into these main branches.

The system of breaking off the young shoots, or glove pruning, as it is generally called, has many advantages. First, the whole strength or substance of the tree is forced into the main branches. Second, the wound caused by the breaking off of young and tender shoots soon heal over, and no scar is left. Third, the pruning can be done more rapidly.

By careful and frequent glove pruning during April and May for several years after planting, the trees will be well balanced, its habits of growth established, no wounds are to be seen on the body or limbs, the bark and foliage will be healthy and vigorous. It is poor economy to grow a limb from one to four feet long and then cut it off, leaving a wound.

I rub off all shoots which have a tendency to cross other limbs and those which grow toward the center of the tree, thereby keeping the main branches in a measure to themselves, growing upward and outward. This method gives me a well balanced tree with an open head.

Many growers differ with me in this open-head idea. I will give my reason for it. I noticed many years ago that the largest and the most highly colored apples, the largest and greenest leaves, and the smoothest and healthiest bark were to be found on the top and on the outside of the trees where they got the most air and sunlight, and in order to expose the most of the tree to the air and sunlight, I adopted the open-head system of pruning, and I have practiced it for many years and shall continue it. It is impossible to have a first-class fruit without healthy foliage and healthy bark, and it is impossible to have them healthy without sunlight and air. My experience is that the largest and the highly-colored apples sell for the best price. Then where is the economy in growing small and dingy-colored apples?

Winter apples should remain on the trees as long as possible before they are gathered. An ordinary frost will not hurt them. When the sound, perfect apples begin to drop, without apparent cause, I know they are matured and I begin at once to gather them, taking great pains not to bruise them; although a bruised apple will not rot unless the skin is broken, it is better not to have them bruised. They are then placed in slat boxes or crates, holding one bushel, and stacked in the fruit house, one above another up to the ceiling, leaving passage ways among the stacks so that the fruit can be examined at any time. This manner of storing apples has many advantages. First, free circulation of air; second, economy in space; third, there is no heating or sweating, as in the case where they are put in bins; fourth, great rapidity and ease in handling. The more I handle apples in crates, the better pleased I am with it. It is a small matter to barrel apples in my fruit house. I have a trough twelve feet long, twenty-four inches wide at one end, and tapering to ten inches at the other end, and placed just high enough to empty into a barrel, and the broad end just elevated enough for the apples to slowly roll down. They are then emptied from these crates into the trough and as they pass down are easily and quickly examined and graded. It is the rule to never barrel or sell apples unless they first pass through this trough. It is very important and very profitable to grade apples. The consumer had rather pay a good price for a uniform grade than a lesser price for a mixed lot.

When I first begun to grow winter apples it became necessary to have a place to store them, and knowing full well that in order for them to keep well they must be kept cool, and how to keep them cool was the problem.

We had no ice factory then, and to build a cold storage plant was out of the question, so to get the coolest place possible I must place them in the cellar. The capacity of the cellar being limited, I concluded to build an artificial cave. I excavated a space ten feet wide, six feet deep, and sixty feet long, walled it up and arched it over with brick, and over the arch was put four feet of earth, and over this was built a shed. This gave a temperature of about fifty-three degrees, which was fairly good, and in which I kept apples fairly well.

As my orchards increased it became necessary to have more storage room, and as a cooler temperature was desirable, I concluded to build a fruit house above ground with double walls packed with sawdust, and cooled with ice, as there was then an ice factory in reach of me. The building was 18x40 feet, inside measure, with ceiling nine feet high, and ice box on the floor in the center of the room with a capacity of 1,000 pounds. After one season's trial it became necessary to increase the capacity of the ice box to 2,000 pounds. For many years I used this fruit house to great advantage, although I could not reduce the temperature to lower than forty degrees. It finally became necessary to have still more room, so I concluded to build a larger and better house, and on more scientific principles.

This building was 40x70 feet, with twelve foot ceiling, inside measure, having a capacity of 20,000 bushels, with floor joist two and one-half by twelve, placed on fourteen inches centers; studding 2x8, ceiling joist 2x12. On the floor of the room, and also the floor of the loft, and on the outside of the studding was placed a cheap grade of 5-8 pine matched ceiling, and over this was placed two thicknesses of tarred building paper, and over this was placed another thickness of 5-8 ceiling. On the outside of the walls was placed a good grade of siding, and then painted. On the floor, and parallel with the main joist, was placed another set of joist, 2x6, and on these a floor of 5-8 ceiling, then two thicknesses of tarred paper, and then the main floor of one-inch pine. The walls on the inside, and also the ceiling, were ceiled with the cheap grade of 5x8 ceiling, and on this two thicknesses of tarred paper, and then a good grade of 5-8 ceiling. This gave me an air-tight house within an air-tight house, with a perfectly dead air space between. On both edges of the studding and the ceiling joist and also on the secondary floor joist, I mean the 2x6 placed directly over the main floor joist, was tacked a two-inch strip of soft building felt before the other building material was nailed on; this practically made the dead air space between the joist and studding separate and independent of each other, so if one by any means becomes defective it affected only a small part of the building. In the north end and the northwest corner, and also in the southeast corner of the building were doors also with dead air spaces. The doors were made with beveled edges so as to fit in tight. On the beveled edges of the door frames were tacked two thicknesses of rubber sheeting, so that when the doors were shut tight they remained so tight that it required an eccentric lever to open them. In the loft was constructed the ice chamber, 8x30 feet, lined with zinc, having a capacity of six tons. This box was made with a gradual descent to one corner, so as to carry off the water through a pipe to the outside of the building, the lower end of which opened into a vessel of water, so as to allow the water to escape and so that no air could get in. Around this ice box is a slatted floor to allow the warm air from the room below to ascend to the ice chamber, to be cooled and then descend to the room below. The reason for placing the ice above is because warm air is lighter than cold air, and as the purpose of the ice is to absorb heat, the two can be brought together better at the highest point. With tons of ice in the ice chamber, the thermometer indicated a warmer temperature there than below. In the ceiling of the main room was placed six ventilator shafts, which extended through the loft and four feet above the roof, and were so constructed as to be closed at the lower end.

Now the secret of keeping apples is to keep them cool, and the cooler the better. I could not reduce the temperature of this house with ice lower than thirty-six degrees, and whenever it was cooler outside than inside, I would open the doors and ventilators so that the outside, or cooler air, could circulate through the building, and in order to hasten the circulation of this cooler temperature, I made a large fan, 24x48 inches, and placed it just inside the door of the ice chamber, so as to force out warm air which collected there, and of course the cool air would rush in from below to take its place. A few moments of vigorous turning of this fan would create a brisk circulation. A feather turned loose in the door below would soon find its way up through the slatted floor into the ice chamber and out of the door above, and after a short time the temperature of the building would change to the same as that of the outside. I would then leave the doors and ventilators open so long as it remained cold, and close up only when it turned warmer. The building being perfectly air tight, there was no difficulty in holding the temperature. This process was continued throughout the winter, and ice was no longer necessary; so I now use ice only from the time I begin to gather until cool nights set in, a period of about forty days. This homemade fan, costing only a few dollars, has saved me hundreds of dollars in ice bills. It is sometimes necessary to start the fan before daylight of a cool, frosty morning in order to catch the temperature at the lowest point. It is important to have two thermometers, one on the outside and one on the inside of the building.

In 1897 I had about 5,000 bushels of apples stored for the winter, and during a bitter cold spell in December, fearing they would freeze, I instructed one of my most trusted employes to close all doors and ventilators tight, and believing it to be done as directed, I did not go to the fruit house for several days, when I found, negro like, he had closed only the front door, and all my apples were frozen as hard as walnuts. The great misfortune proved to be a blessing in disguise. It proved to me that a frozen apple is not necessarily a ruined apple, and if frozen apples are thawed properly they will not be injured at all. I concluded as long as they were frozen I would keep them so if possible until spring, and as the winter was an unusually cold one, this was easily done.

This unfortunate condition of things sharpened my wits as to what was best to be done, so as not to have a total loss. I remembered years ago when I made it a business to grow vegetables for the market, and in order to have them early, I would sow my seeds in hot beds during January, and that in order to harden the young plants so they would stand the transplanting from the warm bed to the cold ground, I would leave the sash off and only put it back when there was danger of a freeze, and that when they would accidently get frosted I would put back the sash, and over them tarpaulin mats, and anything so as to thaw them out in the dark, sometimes leaving them covered for several days. They would generally come out all right with little injury.

I concluded as the fruit house was air-tight and quite dark that the thawing could be prolonged. However, I concluded to experiment some. I took some of these frozen apples and thawed them in the stove oven, which took only a few moments, some on a shelf in the kitchen some distance from the stove, they thawed in about two hours; others were placed in the family room, some in a vacant room where there had been no fire, and some in the cellar, and some I placed in the open air, on blocks of ice with ice all around them, some were surrounded with ice, and ice and all covered with blankets, etc., and as fast as one lot was thawed out it would be placed in the cellar where the temperature was uniform, and each lot numbered, and the place where it was thawed and the time taken to thaw it was recorded, and I found that that those thawed most rapidly rotted the quickest, and the result of these experiments greatly encouraged me.

The great mass of frozen apples in a dark and air-tight room thawed exceedingly slow, in fact it was about March 15 before they were in condition for market, and if they were damaged in the least I could not discover it. Since then it has been my effort to freeze them as early in the winter as possible, and keep them frozen as long as possible, for there is absolutely no decay while frozen. I have noticed also that an apple after it has been frozen is not near so apt to decay as one not having been in freezing temperature. I suppose this is because the frost destroyed the germs which caused the decay.

I have learned many things since I have been growing fruits. I have learned that the more fruit people eat the more they want, and that in some families where it was once a luxury it is now a necessity, and the more opportunities they have of buying the more they buy.

I have not for many years sold my winter apples on the trees, or even at wholesale at gathering time, for with good storage facilities, and with nearby markets, where the people have been educated to eat fruit, it is economy to sell direct to the consumer, and do away with the *middle man.*

A good spray pump persistently and judiciously used is one of the best investments the orchardist can make, for all insect enemies and all fungus diseases can be held in check by it.

FARM DAIRYING.

By J. N. Meroney, of Maury County.

Mr. President, and Gentlemen of the Convention:

I HAVE been requested, by our efficient Commissioner of Agriculture, to make you a little talk on "Farm Dairying in Tennessee."

As I have been personally interested in farm dairying in Maury County for some fifteen years, and am only a plain, practical old farmer, and what I have to say will be plain and practical, but I hope may interest some of you.

I am thoroughly satisfied that Middle Tennessee has many natural advantages to make it a great dairy region, if only our people would interest themselves in the business. All well informed men know that the most prosperous portions of this great country of ours are the great dairy regions of the Northwest, and yet we are highly favored by nature in many ways over those prosperous sections for this business. We have short, mild winters, requiring of us much less expense and labor than is necessary in their long, severe winters, in feeding, housing, and caring for the dairy herd. Instead of the costly double-walled barns that are absolutely necessary there, we need only single-board walls to keep our cows comfortable in our worst winters. We have but three months of stormy winter weather, and often much of that is not severe, while they have eight months of winter that requires constant stabling and heavy feeding to protect their cows and keep them giving milk. And this close confinement produces that dread disease—tuberculosis—so much feared by

Northern dairymen, sometimes destroying whole herds of valuable milkers. We do not have to injure and weaken our cows by this close confinement, so our herds are always healthy. In my observation and experience in Tennessee dairying, I have never seen a single case among our home grown cows.

We have long growing seasons, enabling us to grow two crops a year of many valuable forage plants; while our blue grass, orchard grass, clover, and rye pastures afford green grazing nearly every day through the year.

We have an abundance of pure running water on nearly every farm that is cold and healthy in summer and does not freeze up solid in winter. All practical dairymen highly appreciate this advantage.

As to markets for dairy products, the large Southern cities furnish the best markets in the world. They are now supplied with all their butter and cheese and much of their milk by the dairies, creameries, and cheese factories of the Northwest. While we are in direct railroad communication with them, and with the advantages of being from five to eight hundred miles nearer to these markets than our Northwestern competitors, this fact is surely to our advantage.

But successful and profitable dairying requires good cows and good, cheap food for them. We can have both of these. There has been for perhaps thirty years some very fine breeding herds of thoroughbred, high-grade Jerseys located in the Middle portion of Tennessee at different points. From these herds good milking Jersey grades are widely scattered over our country, and can be found on nearly every farm, the best foundation on which to build up paying dairy herds to be found in any country—good, rich, healthy milkers. Our climate and surroundings seem to suit the Jersey milker even better than her native island, if given the same attention.

As to cheap, plentiful, and satisfactory food for dairy cows, we get that through the use of the silo.

A silo is any kind of an air-tight structure, used to preserve the green, rich, succulent crops of summer for winter feeding in as near their natural state as possible. These structures can be built of stone, brick, cement, or wood. They are built of various forms, square, oblong, eight-cornered, or round, so they are air-tight and have sufficient depth to give the necessary pressure to expel the heated air, they answer the purpose.

But I must describe the silos that I use, because I have found them both cheap to build and satisfactory for the purpose. I have had these silos in constant use for twelve years and they have never failed to give me entire satisfaction.

They are round stave structures, easily and cheaply built, costing less than one dollar per ton capacity when built.

I first dig a round cistern in the ground eight feet deep and of the diameter I want the silo; then lay around the top of this cistern a circle of brick, laid in cement mortar and two bricks thick as the foundation for the wooden part of the structure, which is made of two by four pine studding set up on this brick foundation like a huge tub. To build this tub a scaffold is needed so that one person can work at the top and one at the bottom to put the staves in place. When the first one is set up and made perpendicular, it is nailed to the scaffold at top to secure it in place; across this first stave there is an old barrel stave nailed, on the inside, near the top, another near the bottom; the second studding is set up, placed as close as possible by the side of the first and secured in place by small nails driven through the old barrel stave, and so on, conforming to the circle of the foundation until the tub is complete, standing on the brick foundation and held in place by two complete inside hoops of old barrel staves. Then the iron hoops are put on; these are made of 5-8 round iron rods with screw threads and nuts on each end, each hoop is composed of two or more sections of these iron rods, with the ends passing through iron lugs from opposite directions, so as to draw against each other. For a silo twelve feet inside diameter, three sections of the round iron rods about thirteen feet long will compose each hoop. I use eight complete hoops for my fourteen feet height of wooden tub, this makes with the eight feet of earth cistern a silo twenty-two feet in depth. Any depth can be used, but less than twenty feet is not satisfactory, and twenty-four feet is better. When all the iron hoops are on and drawn up tight and fast, from top to bottom, then saw out the doors between the hoops just large enough for a good-sized feed basket to pass through, say 24x30 inches; saw out two doors, one about one foot from the ground, the other seven or eight feet. Saw them with a bevel larger on the inside, so that when put in place in filling, the pressure of the silage will make a tight joint. I also tack a square of tarred roofing paper over the door on inside to be sure the joint is air-tight. Cement around the bottom where the wooden tub sets on the brick foundation and down on the clay wall about two feet to the solid firm clay. It is necessary to cement the wall if it is a firm, hard clay; the silage keeps perfectly in close contact with the clay wall, and my clay walls are just as good as when dug twelve years ago. I am aware that there are some places where the solid stone is too close to the surface to use this underground part; there are other places where water rises up in pits excavated but little below the surface; in either instance this combined wood and earth plan will not do, but whenever there is a good firm clay subsoil, this is the cheapest silo to build, most convenient to fill and feed from of any other plan, and will always give satisfaction; should always be built close to the cow stables.

Now, as to the material to fill the silo. I will say I have tried several crops; corn alone, sorghum alone, corn and sorghum mixed with peas and soybeans, but after carefully testing them all, I have for the past five years used a mixture of corn and cow peas ground together, and I believe this to be a nearly perfect ration for winter dairying. The corn should be well eared and the peas as rich in grain as it is possible to grow them.

I find in the Albemarle prolific corn and the whippoorwill pea the material that is hard to beat. This corn grows tall, bears from two to eight small ears on every stalk, has heavy growth of leaf and shoots, a splendid root growth, enabling it to stand drouth well, matures evenly over the field and is ready for the silo in ninety days after planting.

The whippoorwill pea does not make as heavy vine growth as some varieties, but produces more grain than any pea we know of, and if planted with the corn will mature a fine crop of peas just in time to be ready for the silo with the corn.

I want all the grain I can get of both the corn and peas in my silage for the purpose of making a satisfactory ration for milk production at home, and not having to purchase the expensive mill feeds, bran and oil meals, all of which are now controlled by trusts, combinations, and monopolies, and are sold at exorbitant, almost prohibitive, prices to the dairymen who have to buy them. By combining these two farm grown, home raised feeds we save this heavy outlay. The corn is the best fat and heat producing food we know of, and there is no grain grown richer in protein, the milk and muscle producing element, than the grain of the ripe pea; while the vine is as rich and valuable a dairy food as clover. Combining these two in our silage, under the best possible conditions of production, we can be entirely independent of these grinding monopolies, have a perfectly balanced home grown dairy food at a low cost. I used to pay out $30 to $50 per month for bran and cotton seed meal, and thought I could not do without them. Then the profits of the dairy went to the miller's combinations, but now by growing my own balanced milk producing ration on the farm, I save that outlay, and my bank account makes a better showing on the deposit side of the ledger. But let me insist that all the grain, both the corn and the peas, be put into the silage.

But I am asked, how must I do this? I will give my plan. It is simple, practical, and effective. Plant the two grains together, cultivate and harvest, and put in the silo together, and you will have an even and regular mixture and the best and cheapest cow food in the world.

I prepare the ground well, deep subsoiling, thorough pulverizing, and not plant too early; the 1st to the 20th of June is early enough for this mixed crop. To plant I use a two-horse corn planter, put corn in one box and peas in the other, drive across the field, plant corn in one row, peas in the other, then turn and drive back in the same track. This will plant corn in the pea row and peas in the corn row, and so on over the field; and if it is dry weather this double pressure on the grain insures a perfect stand. I then use a light drag harrow or weeder before the corn comes up to destroy any weeds starting to grow, use the weeder again as soon as the corn has three or four leaves, going with the rows first, then across the rows. This kills all the little weeds just as they are starting from the surface, but does not hurt the corn or peas whose roots are below where the weeder stirs. When the crop is some six inches high, I plow out thoroughly with narrow points on cultivator or on double shovel, plowing very close and as deep as the mules can pull the plow; this is to loose the ground deep so the little roots can penetrate in their search for plant food. I never plow deeply any more, cultivate shallow, level, and frequent with the weeder and small fourteen-tooth, one-horse, steel harrow. I never want to break a corn root. Keep a loose dust cover about one and one-half inches deep all the time by constant, level, shallow cultivation. Cultivate every few days until silks show on corn all over field, and you need not fear a drouth. You will make good cow feed and plenty of it, and the cheapest and most satisfactory food in the world for winter feeding.

To harvest this mixed crop I use the McCormick corn harvester, set low, and I save all but the roots of both the corn and peas; and the crop is bound up nicely in bundles, convenient to handle. The proper stage to harvest the crop is when the corn is well glazed and too hard for table use. Do not cut down too much at a time, and put it into the silo as soon as possible after the harvester. Do not let it get dry.

In saving silage we are almost independent of weather conditions. Not like hay making, if rain comes we only have to wait for the drops to cease falling, then the work goes on. Do not have to wait for sunshine like saving hay.

The yield is from eight to fifteen tons per acre, and more good food can be safely stored in the silo than any other equal space; and when stored it is practically safe from destruction by fire or lightning. This giving the food much the advantage in security over hay or dry fodder.

All kinds of stock like good silage, but its superior excellence is as a cattle food, both for the dairyman and the beef feeder.

So with the best kind of foundation for a dairy herd, the cheapest and best of feed desirable, favorable climate, good grass lands for pasture, water pure, permanent, and plentiful, located near to paying markets, with a steady demand for dairy products, why cannot Middle Tennessee be made a great dairy region? Statistics are usually dry subjects, but I ask to give the facts and figures from one county in Wisconsin for last year: Portage County supported twenty-three creameries, which made and sold 1,221,925 pounds of butter, 27,633 pounds of cheese. Those products sold for cash returns of $294,066. This from one county in that cold country. And we have at least ten counties in Middle Tennessee that could do as well, or even better, with their superior natural advantages.

The business has no risk about it. The money is coming in every month in the year, instead of only once a year, as is the case with a grain or cotton crop. The feeding of the products of the farm at home and carefully saving the manure will steadily build up the worst run-down farms in the State.

By the use of the hand separator in our farm dairies we get all the profitable butter fat out of the fresh milk, leaving the good, sweet, warm skim milk in its best condition to feed the pigs and calves, which is quite a source of profit to the farm dairy. And by selling off only the manufactured butter there is absolutely no elements of fertility sold off the farm, but every year the dairy farm will increase in fertility and productive power. You all know this is not so if we grow continuous crops of cotton, grain, or hay to sell off the farm, but every such crop sold off the farm carries with it more or less of the fertlity of the farm, making it poor year after year.

We have every reason to encourage the business of farm dairying in our State, and every reasonable prospect of it being made a safe and profitable business. I want to see old Tennessee, my native State, be made a prosperous and profitable dairy region.

I thank you, gentlemen, for your very kind attention.

POULTRY RAISING.

By Holcomb Robertson, of Chester County.

THIS industry is much neglected by the average farmer, and not understood, as a rule, from the fact that they are not reading the poultry journals to get the necessary information to successfully raise poultry. This is easily done, however, if one understands his business, and it is both pleasant and profitable. The farmer's wife can make more money raising poultry for the market than any think she can engage in.

In this article I shall endeavor to give my own experience in raising poultry, and I am in accord with the leading poultry journals. First, I will begin with the hen house. This must be kept perfectly clean and dry, dampness is detrimental to both old and young chicks. All dampness and bad odor about the hen house will bring about the germs of disease. As an absorbent of bad odors, common road dust is execellent, though not a disinfectant. Thoroughly disinfect the house, roosts, and all with kerosene oil and whitewash with lime. Add a little soft soap and paraffine to the whitewash and it will adhere to the wall better. Cleanse nests in the same way. A little ashes and dirt in bottom of nests will round out the corners and make eggs concentrate to center and give better hatch. Do not use coal oil after eggs are in nest, as an egg will not hatch if coal oil or any other grease should touch them. Should an egg get broken in nest take a little warm water, cleanse and dry thoroughly. The pores of the egg shell must be kept open or they will not hatch.

Little chicks do not require feed for first twenty-four hours. The yolk of the egg just encased in the body as the chick emerged from the shell is sufficient nourishment for that length of time. First give them fine grit, the first feed should consist of corn, wheat and oats ground together, sift and make dough, bake a cake of this, in ashes, very brown, then soak in water until soft. This is easy to digest; Never feed corn dough made of cold water, as it tends to sour in their crops and causes indigestion, and many of them will droop and die. Do not let them roost in cold, damp quarters nor run out in dew, as it will bring on gapes. When a few days old they will take millet seed and cracked grain, corn or wheat. Feed often, but be careful to never overfeed. When a little older they must have green food. If yarded and they cannot get to it, you must supply it in some way. A cabbage head, or most any green vegetable. Never allow a dead carcass of any kind to stay about the range of fowls, as the carcass becomes infested with maggots; the fowls will eat them and cause limber neck. If you find a chick with limber neck, give from a few drops to a teaspoonful of coal oil, according to age and size. Little chicks properly fed and cared for will make good broilers in eight or ten weeks. Many farmers do not have eggs in winter when they sell highest. If hens are properly fed for eggs they will lay all winter. They require green food, however, and if yarded and cannot run on grass, or clover lot, wheat or oats, then you must supply the green food in the yard by giving a cabbage head, or any green vegetable, and plenty of fresh water at all times. They need meat scraps about twice a week, also charcoal and lime in some way. They will greedily eat old lime mortar. They must have dry, warm quarters in which to roost in winter. Feed them a mash in morning of corn, oats, and wheat ground together; wheat and oats at noon, and corn at night. All grain should be fed in a shed prepared with litter of some kind, scatter the grain in the litter, and let them scratch for the grain. This gives exercise which is very necessary, as a lazy hen seldom ever lays, she gets too fat. Corn is a fattening food. Wheat and oats are bone and nerve food, also good egg food. Sunflower seed gives them a fine, glossy plumage, and is also good for health. For market poultry the larger breeds are preferable. I prefer the Plymouth Rock or Wyandotte. They belong to the American class, and market poultry men breed the barred Plymouth Rock more extensively than all other pure breeds combined. The Barred Plymouth Rock have attained a popularity never before known in this country, and makes them the bird of destiny, a breed come to stay. The Wyandottes are next in point of merit. All the Asiatic classes are large market poultry, embracing light and dark Brahmas, all the different Cochins, aso Langshans. These are the "booted tribe," and all good market poultry, and some are good winter layers also. But for eggs, I prefer the Mediterranean classes that embrace all Leghorns, Minorcas, and most all the smaller breeds. I would never cross any of the standard bred fowls; you will not improve either breed. Better perfect one strain. The cross I prefer is Barred Plymouth Rock with common hens of the country. When farmers do not care to buy full-blooded fowls to start with, this cross will nearly equal full-blooded for market poultry. I have never found any other cross equal to this cross. As to the remedies of the various diseases of fowls, I find an ounce of preventive worth a pound of cure. I woud not be afraid to insure poultry if sanitary rules are rigidly observed.

The raising of turkeys is a very profitable business. I have tried several varieties, though prefer the Mammoth Bronze for both hardiness and size. The same rules apply to them as to other fowls. Keep the young turkeys in warm quarters, out of cold dew and rains. Some feed hard boiled eggs for first feeds. I like a mixed feed better; something that builds up both bone and nerve along with body, and this is best done with mixed feed already referred to in this. Turkeys are valuable on a farm, destroying many insects so injurious to crops, and they pay well for market fowls. They usually go away from the house to lay, and must be watched closely, and when ready to set can be removed to the house by building a pen in which the nest can be made, and the turkey confined in the pen. Be very gentle with her in moving her, and work quietly and she will set all right after awhile. Feed and water her in coop until well accustomed to the new quarters, then you will have no more trouble with her sitting.

SOME DISEASES OF FRUITS AND THEIR METHODS OF TREATMENT.

By Samuel M. Bain,

Professor of Botany, and Botanist of the Agricultural Experiment Station, University of Tennessee.

THE day has come when every person who would raise fruit successfully must reckon seriously with the living enemies that lurk on every side ready to prey upon his crops. The ubiquitous small boy, with insatiable appetite for fruit is, it may be stated, the least important among these enemies. The most serious impediment to the full and successful development of the fruit growing industry in our State is the general neglect of recognizing the insect and fungus pests which have been disseminated among us. Within the last twenty-five or thirty years methods have been worked out for the more or less successful prevention of many of these insects and diseases. It now only remains for the growers of fruit in the State to put into practice these methods already learned and tested and thus to save their crops.

The question is often asked, Why are our fruits so much more subject to these diseases now than they were in the days of our grandfathers? I shall not have the time or space to go into a full discussion of this problem, but will simply call attention to one or two features of it. In the first place, by importation of fine varieties of fruits from remote parts of the earth, we have brought along with them certain diseases and insect pests which did not exist here before. In the case of insects, we have in many instances imported the pest without importing its natural enemies. This gives the pest free and unchecked play, and it increases at a prodigious rate unimpeded, and thus in many instances may work far greater havoc than it does in its native home. The destructive San Jose scale is a striking case of this sort.

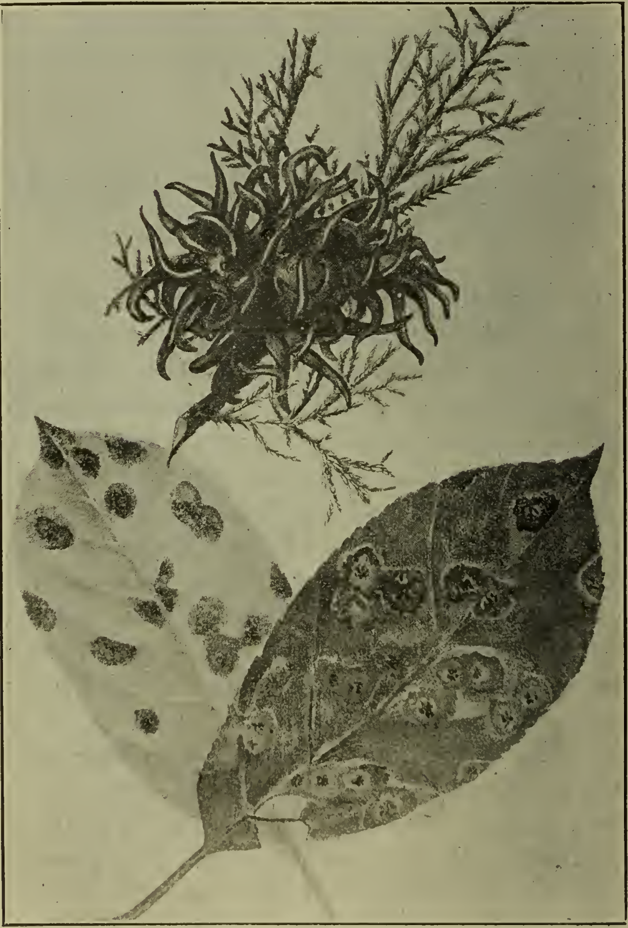


Fig. 1. Cedar apple, and apple leaf rust.

In the next place, by careful selection our fruit varieties become more and more desirable in flavor or appearance, but in many cases they have become, so to speak, more delicate in constitution and more liable to disease. This factor becomes more evident still where these fine varieties are neglected and poorly cultivated. In a sense, the same law holds with reference to our fine breeds of live stock. The Jersey cow is recognized as one of the very best butter producers if properly fed and cared for, but if the farmer will insist on allowing her to run exposed to the varying conditions of winter weather, poorly fed and maltreated, he had best invest at once in a herd of scrubs, for they will doubtless give him better results under such treatment.

Contrary in a sense to the popular impression, it is none the less true that all of our fruit diseases are caused by definite, specific and natural agencies. It is a well-known fact that during warm and moist weather peaches are far more subject to rot than under the opposite conditions. It is erroneously supposed by many people that the warmth and moisture are the direct cause of the rot. The rot is caused by the growth of a distinct organism or plant, the brown rot fungus, which, like most other plants, grows most vigorously under these peculiar conditions, and thus it comes about that fruit is, under these conditions, far more apt to rot. The fact is, no fruit would ever rot, so far as we know, if none of the germs of the organism causing rot obtained access to it. We may in different ways destroy these germs or spores (seeds) of the fungus and thus protect the fruit. In canning peaches, for instance, the fruit covered with sufficient water is brought to a boiling temperature and at once sealed up air-tight. If properly sealed, it will in this way keep indefinitely, simply because no putrefactive germs can gain access to it. The results of exposing a jar of fruit for a few days after it has been opened is well known.

What has been said of fruit is likewise true of all kinds of organic matter capable of decay, or decomposition. For instance, bread left in a damp situation will in a few days become covered with mold. This mold is simply the result of certain plants whose "seeds," or spores, have been dropped there and set up growth. So abundant are these spores in the air everywhere that they find lodgment on bread wherever placed, and we confidently expect the mold to manifest itself if we supply the proper conditions, and are never disappointed in this expectation.

The spores of all forms of fruit diseases, molds, etc., are almost inconceivably small. They are carried about in the currents of air. A ray of sunlight admitted through a blind into a dark room will reveal thousands of minute particles of dust floating upward, downward, in all directions. These dust particles are large enough to be seen with the natural eye, and hence must be much heavier than the minute spores of fungi causing rusts, rots, etc. It is, therefore, easy to see how these germs are carried by the wind and thus scattered from place to place.

What then becomes of these germs thus floating around in the air? It is a well-known fact that seeds of our various cultivated plants will not germinate when the soil is very dry. Corn, beans, etc., require a certain amount of moisture before the seed will germinate, and the same is true of our disease germs. If they alight on a dry surface they will not grow. But if they chance to fall in a drop of water they will germinate far more quickly than the seeds of ordinary plants, usually within a few hours. It is a well-known fact that foliage and fruit are frequently covered with dew at night and often wet by showers in daytime. One of the spores of any of the fruit diseases mentioned below would have ample room for development in a drop of dew far smaller than the head of a pin; hence, it is seen that all the necessary conditions of growth are supplied in a state of nature for these pests to gain access to the vital parts of leaves, fruits, or twigs. The spores sprout in a short time, send their minute microscopic roots into the fruit or leaf or stem, where they grow and branch luxuriantly as they feed upon the tissues of the plant, and eventually produce all the symptoms which we know as characteristic of the disease. All these facts are readily demonstrated by the microscope, and are just as real as any other facts of everyday experience.

One more point must be mentioned. All these low forms of plants are dependent on chance for their distribution from one place to another. In many cases a certain disease will occur on only one kind of tree. There may be several hundred yards space intervening between this tree and another of the same species. It is clear that in order to insure that some of its progeny will reach the proper place for growth a fungus must produce many thousands of spores, and that by far the greater part of them "fall on stony ground" and must perish. As a matter of fact, we find that all these disease germs are produced in prodigous numbers. For instance, recently in one of my classes, where we were studying corn smut, the question arose as to the approximate number of these spores occurring on one ear of smutty corn. We found on counting the number of spores in a few minute masses of the black powder, that ten million was far below the probable number!

Having thus considered in a general way the causes of these diseases, let us now take up some of them in detail.

THE APPLE.

Several serious diseases of the apple occur in Tennessee. One of the worst is the apple leaf rust. Evidences of it appear in the spring, soon after the leaves have put out, in the form of minute yellow specks. The leaves finally turn yellow and drop off, thus impairing the vitality of the tree. This disease has a peculiar habit, shared with a number of other diseases, of living two cycles of existence. The spores formed in great numbers on the apple leaves cannot grow into the apple leaf, and in fact will grow nowhere except on the young and tender twigs of the red cedar tree. Here they produce a growth resulting finally in the formation of a peculiar gall, which we know popularly as the cedar apple. These cedar apples may be seen in wet spring days bristling with orange-colored jelly-like strands. This jelly-like substance is filled with thousands of spores, which will spread the disease to neighboring apple trees. Thus we see that while the disease is in no danger of communication from one apple tree to another, one cedar tree may be instrumental in scattering it over an entire orchard. Obviously, the common-sense means of preventing the spread of this disease is to cut down the

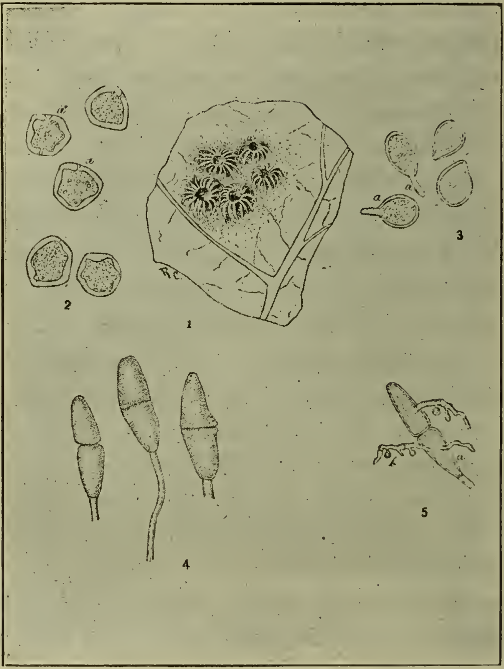


FIG. 2. Spores of apple leaf rust at 1, 2, and 3.
Spores of cedar apple at 4 and 5.

cedar trees about the orchard. Those growing within a circle of several hundred yards should be removed.

Bitter Rot—Another disease of the apple demanding attention is known as bitter rot. This disease plays greater havoc with some varieties than with others. It frequently attacks the fruit by the time it is half-grown, causing round, decayed areas which soon involve the whole fruit and spread to others in its vicinity. The spores are soon produced in great numbers and the disease thus rapidly spreads, not only to other fruits but also to the twigs and branches, causing a disease known as limb canker. This disease is so easily recognized and is so generally familiar that no further description seems necessary. I recently saw in Lauderdale County a magnificent crop of Winesap and Ben Davis apples of which fifty per cent were rendered unfit for market by this disease.

For the control of this disease the trees should be thoroughly sprayed with Bordeaux mixture, the first application being made a little before the rot is in the habit of making its appearance. The fruit should be kept well covered with the mixture until it is ripe.

The apple is also subject to the same disease which attacks the pear, known as *fire blight*. Since the same rules hold in its treatment on the apples as on the pear, it had best be considered under diseases of

THE PEAR.

The blight is by far the most destructive disease to which the pear is subject, and as just stated, the apple is not proof against its attacks. The blight is caused by bacteria, the same general class of organisms which produce in the human body such diseases as scarlet fever, tuberculosis, etc. The chief method of dissemination of the disease is through insects which visit the flowers. The germs are unable to penetrate the old bark of twigs and branches, but after they once gain access through the tender parts of the flowers or an injured part of the bark, they may make their way back into the very trunk and finally destroy the whole tree. No method of spraying or other treatment so far known can destroy this or any other disease which has its seat in the wood, protected by the bark. The only reliable means we have for treating this disease is to cut out carefully and promptly all affected parts and burn them. It is necessary in every case to cut back into good, sound wood so as to remove every vestige of diseased tissue. It is advisable also to dip the knife into a solution of corrosive sublimate (one part to 1,000 of water) after each cutting, so as to avoid every possible source of contamination. This pruning out process should be followed assiduously, especially during the blooming period. It has been conclusively shown that this disease can be controlled by constant vigilance and application of this method.

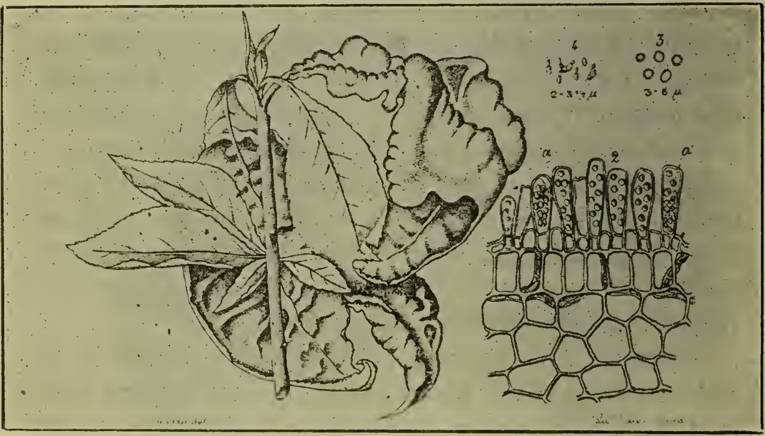


FIG. 3. Peach leaf curl, natural appearance, with spores shown at 2, 3 and 4 much enlarged.

Several other pear diseases are known to occur in Tennessee, but they are not frequent and will not be considered here.

THE PEACH.

The most important peach diseases in Tennessee are the leaf curl and the rot.

The former is familiar to everyone at all familiar with peach trees. It is caused by a fungus, whose spores are set free on the surface of the curled leaves, as shown in Fig. 3. This disease sometimes assumes a very serious form and does considerable damage. It can be very successfully prevented by spraying with the Bordeaux mixture in the early spring before the buds swell.

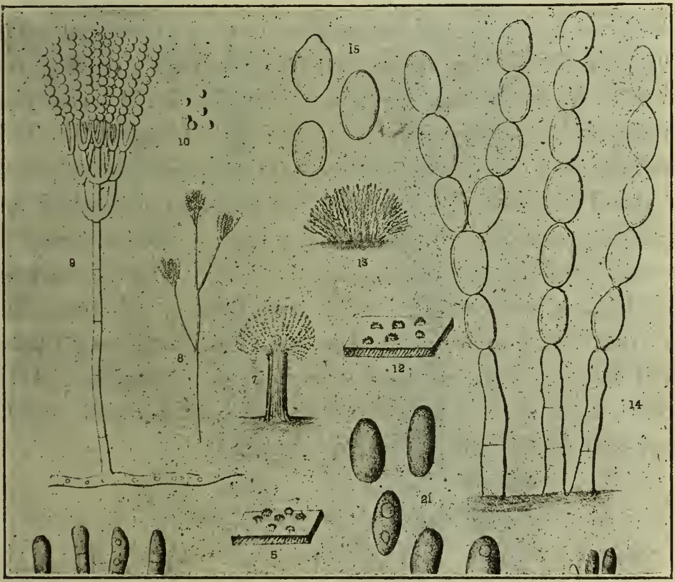


FIG. 4. Spores of peach rot fungus greatly magnified.

The brown rot of the peach (also attacking all other stone fruits) is one of the most serious fruit diseases known in the Eastern United States. It not only attacks the fruit, causing it to rot as it approaches maturity, but it also attacks the blossoms, causing them to blight, and passes from them back into the twigs, and thus causes considerable damage to the trees. Figure 4 shows the appearance of this fungus under the microscope. They are produced in untold thousands on every rotten peach, and spread the disease in the usual way to other trees. It has been fully demonstrated that this disease may remain alive from one year to another in the old peach mummies on the trees or on the ground, which fact emphasizes the importance of clearing the orchard of rotten fruit as soon as the crop is harvested.

The chief difficulty in the way of the treatment of peach rot by the usual fungicides is the extreme susceptibility of the foliage to the spraying mixture, so that frequently more damage is done to the tree by the spraying than would occur from the disease untreated. This problem has received several years' careful investigation at the Tennessee Experiment Station, and a method has been devised for preventing the injury to the foliage. In several preliminary experiments this has proved successful, but on account of the failure of the peach crop, due to winter killing, for several seasons past, a thorough practical test on a large scale has not been possible. It is hoped, however, in the near future to obtain some results that will be valuable in a practical way.

THE PLUM AND CHERRY.

The plum and cherry are also, as above stated, subject to this rot disease, and the same remarks made as to the treatment of the peach also apply, in a certain sense, to the rot of the plum and cherry. It should be stated, however, that full and satisfactory tests of spraying methods for preventing this disease on stone fruits are as yet wanting.

There is another serious disease of the plum and cherry more or less prevalent in the State of Tennessee, probably more abundant in the eastern portion, known as the black knot. This peculiar disease, like most of the others treated of in this paper, is due to the attack of a fungus, causing the young and tender branches to assume a peculiar growth, resulting in the formation of knots, as shown in Fig. 5. This is another disease which resides in the tissues of the wood, and for that reason cannot be reached by spraying mixtures. After a tree becomes affected with this disease the only remedy is to cut out the affected parts, remove and burn. If taken in time the disease can easily be held in check, but if allowed to go without attention the tree will soon be destroyed. If a tree is very badly affected the best plan is to cut down entirely and burn. There are other diseases of the stone fruits known to occur within the State of Tennessee, but they do not as yet demand serious attention.

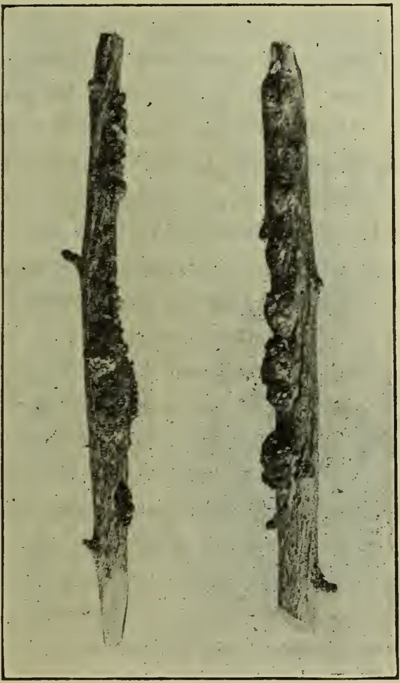


Fig. 5. Black knot of plum, appearance to natural eye.

THE GRAPE.

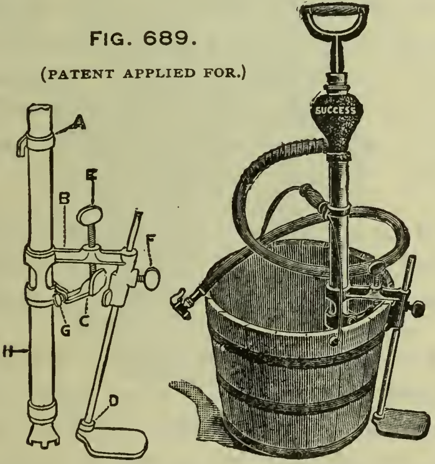
The most important disease of the grape in the State of Tennessee, and the only one deserving serious attention at present, is the black rot. This disease is the one commonly causing the grapes to rot and dry up, frequently long before ripening time, and is so well known to the grower that an illustration is not necessary, or even a minute description. The disease is caused by a fungus which attacks both the berries and the leaves of the plant, causing more or less serious trouble on both. This disease can be very successfully prevented by spraying with the Bordeaux mixture. The method will be given below in further detail. It should also be stated that grapes can be protected from this disease, as well as from other diseases, and even from insect pests, by bagging. The most satisfactory method of procedure is to take one or two-pound paper bags, depending on the size of the bunches and the variety under treatment, and pin them over the back of the vine on which the bunch grows, within as short time as possible after the blossoms have dropped off. The grapes will develop normally in the paper bag and will be protected from the spores of the black rot or other disease. In many cases it will probably be more satisfactory to bag grapes than to spray them, especially where spraying is not practiced on any other fruit, and where only a few vines are grown for family use. The chief advantage is that after bags are once put on no further attention is necessary for protection from diseases.

THE RASPBERRY AND BLACKBERRY.

The raspberry and blackberry are known to be attacked by several diseases in this State. The most important is that known as the orange rust, which is so well known in appearance on wild as well as cultivated berries that no illustration is necessary. This disease is known to remain alive in the roots and older canes of both plants, and after a cane is attacked one year it will continue on that same plant and so far reduce its vitality that if it is not killed outright it will not bear fruit of any consequence. At the same time the presence of an affected plant will spread the disease to others in the vicinity and may eventually destroy a whole plantation of berries. The only method which has proved satisfactory in practice for keeping down this disease is to watch carefully after the plants, and as soon as any one is shown to be attacked by rust take it out, root and branch, and burn it. At the same time it is necessary to see that no rusty wild plants are allowed to grow along fence rows or other neglected places in the vicinity of the plantation.

FIG. 689.

(PATENT APPLIED FOR.)



A cheap form of sprayer for use in small garden or vineyard.

There have now been treated in greater or less detail most of the important diseases of fruits which occur in this State. It is now necessary to describe, at some length, the practical methods of spraying. Of course attention has been called in several instances to the futility of spraying as a method of treatment in a number of cases. The fact should be emphasized that in every case it is desirable to know exactly what disease is being treated, and to proceed intelligently for its prevention.

There are, in general, three different mixtures used for spraying for plant diseases. The first is known as the ordinary bluestone solution, and is made by simply dissolving

Bluestone	2 pounds
Water	1 barrel

This mixture should be applied in every case to the trees or vines in the winter condition. The application may be made in early spring before growth starts, but bluestone solution cannot be used on trees in the growing condition, since it is very destructive to the foliage. This early treatment should not be neglected, since it is of great importance for the destruction of any disease germs which may linger about the trees or vines. The next mixture, and the one of greatest importance, is known as the Bordeaux mixture. This is composed of

Bluestone	6 pounds
Unslacked lime	4 pounds
Water	1 barrel

The bluestone may be more quickly dissolved in hot water contained in a wooden or stone vessel, but should not be put into tin or iron vessels. Only good, hard and fresh lumps of unslacked lime should be used in making this mixture—lime that would make good mortar. Air-slacked lime is unsatisfactory for a number of reasons and should not be used. The lime should be slacked carefully and strained through a fine wire strainer, except where the sprayer has a special attachment or strainer for keeping out foreign particles. In any case, if the lime should contain impurities it should be strained after thoroughly slacking. The bluestone should, after being dissolved, be put into the barrel nearly full of water, then slacked lime should be poured in, and the whole stirred up thoroughly (the barrel being filled), and applied at once. The Bordeaux mixture, in the case of all diseases, should be applied before the plant in question is subject to the attack of the disease. For instance, in the case of the bitter rot of the apple it is not necessary to make an application sooner than within a few weeks after the blossoms drop off, and usually only two or three sprayings would be found necessary in that case; but such a disease as the black rot of the grape requires an application of Bordeaux mixture as soon as the blossoms have dropped off, and thereafter an application should be made at intervals of a few days to two or three weeks, depending on the condition of the weather. In case of frequent rains, when the mixture is washed off to a greater or less extent, more frequent applications will be found necessary. These

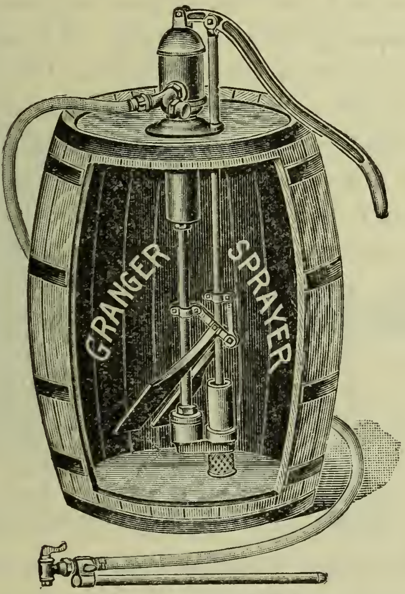


FIG. 6. A cheap and efficient outfit for general use.

applications should be kept up in the treatment of every disease so long as the fruit is subject to that disease.

In the case of the grape, and probably in some other instances, it is desirable not to use a mixture containing lime towards the ripening time, for the reason that the fruit is thus soiled, and to a certain extent rendered undesirable for market. Another mixture is used in this case for the latter one or two sprayings, so as to have the fruit reach the ripening period in a thoroughly cleanly condition. The mixture used for this purpose is known as the ammoniacal copper carbonate mixture. To make this mixture take one quart of strong ammonia (26 degrees) and put into it copper carbonate, about half a teacupful. This should be shaken up thoroughly at intervals and allowed to stand for a day or two, so that the ammonia will dissolve all that it will hold. When needed for use, pour off the clear blue fluid above the powder that has settled to the bottom. Pour this liquid into a barrel of water and apply at once. This is a clear blue fluid which will not soil the fruit.

A few words are necessary by way of discussion of spraying apparatus. It is very desirable to obtain a good pump to start with. The pattern shown in Fig. 689 is found very satisfactory where only a small amount of spraying is to be done. The method of attaching this pump to the bucket is clearly indicated in the cut. The writer has used an apparatus of this pattern for several years and has found it entirely satisfactory where only a few vines are to be sprayed. It has the advantage of being removable from the vessel containing the spraying mixture and easily cleaned. It, however, would be entirely unsuitable where spraying had to be done on a large scale. In the writer's opinion, the knapsack sprayer is undesirable for most purposes. The labor involved in carrying a large vessel about on the back all day is too heavy where a horse may be easily hitched up to a cart or wagon and the spraying apparatus hauled about the orchard. The most desirable spraying apparatus for general use on the farm, which is at the same time cheap in price, is the one shown in Fig. 6. This can be hauled on a cart or put into a wagon, and will be found entirely satisfactory for most purposes. A number of minor points will readily suggest themselves to any one of average intelligence or experience in handling machinery, such as the fastening of a long rod to the hose carrying the nozzle, as shown in Fig. 6, so as to enable the operator to reach up into tall trees. A few precautions are necessary in the purchase of the instrument. In the first place, it is the writer's opinion, that no nozzle has yet been put on the market that is superior to the Vermorel, one form of which is shown in Fig. 8, although many experimenters recommend the Bordeaux nozzle, shown in Fig. 9.

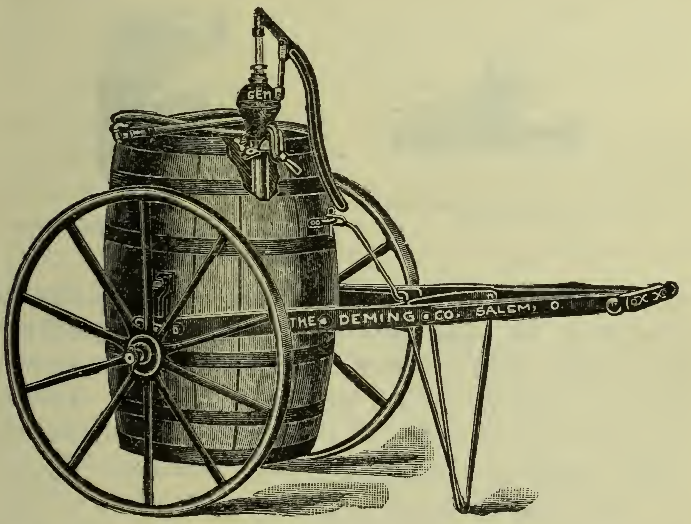

GEM
THE DEMING CO. SALEM, O.

Fig. 7. A more expensive spraying outfit than the one shown in Fig. 6.

In spraying, the effort should be made to cover with a uniform, dew-like deposit all parts of the plant that it is desired to protect from the disease. It is to be remembered that these mixtures prevent the disease only on the portion of the plant covered by them. A fungus spore can obtain lodgment and germinate within a very small space. As soon as the leaves begin to drip the spraying should be stopped. The nozzle should be moved constantly about, so as to reach every part of the plant as far as possible.

In conclusion, it should be stated that spraying methods are no longer in the experimental stage, but that practically every commercial fruit grower in the country has recognized the importance of spraying, and considers it an essential feature of cultivation, and provides as regularly for spraying as for plowing or pruning. Diseases become more numerous as years pass by, and for this reason spraying becomes the more necessary. It may be stated that no instance is on record where a fruit grower in the State of Tennessee has been advised to spray that he has not become enthusiastic over the results obtained and continued the method.

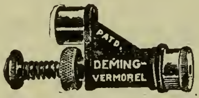


Fig. 8. Vermorel nozzle.

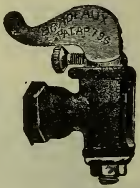


Fig. 9. "Bordeaux" nozzle.

ON THE RATIONAL USE OF FERTILIZERS.

By Prof. Chas. A. Mooers, State Chemist.

TO the farmers of Tennessee the fertilizer problem is one of great and of increasing importance. "What kind of fertilizer, and how much shall I use?" are questions repeatedly asked.

I take it for granted that the reader understands that there are at least four necessary kinds of plant food which are frequently deficient in a soil. These four kinds of plant food are known in agriculture as phosphoric acid, potash, lime and nitrogen. Now, let us suppose, for argument's sake, that every particle of any one of the three elements, lime, phosphoric acid or potash, be extracted from an otherwise fertile field. What would be the result? In spite of an abundance of the other kinds of plant food all vegetation would die. The wild onion and the Johnson grass would soon be perfectly eradicated. With the leaching away of the partly decayed vegetable and animal matter, the humus of the soil, the amount of soluble mineral matter would decrease, and with the decrease of these substances the clay would be more easily washed away than before, until finally that which was once a fertile soil would be changed into a waste of sand, gravel and rock. One of the signs of a lack of humus and of lime in the soils of Tennessee are the muddy streams after every rain, for where the soil is richly supplied with humus and lime the streams remain comparatively clear even at the seasons of heaviest rainfall.

Before considering the plant food deficiencies peculiar to Tennessee soils, let us briefly notice the requirements of different crops. Farm crops may be divided into two great classes, leguminous and non-leguminous. To the leguminous crops belong beans, peas, peanuts, the different varieties of clovers, vetches, etc. To the non-leguminous crops belong corn, wheat, grass, potatoes, and the like. To understand that peas, beans and clovers are able, by means of the microscopic organisms living on their roots, to gather from the air all the nitrogen they need is of fundamental importance in the rational use of fertilizers. Hence a complete fertilizer for any leguminous crop need contain only lime, phosphoric acid and potash. To be more definite, a mixture of, say 300 pounds of acid phosphate and fifty pounds of muriate of potash would be a complete fertilizer for cow peas or for clover, and to use nitrate of soda, cotton seed meal, blood or tankage in addition would be neither good theory nor good practice. On the other hand, a complete fertilizer for corn, wheat, grass or potatoes must contain nitrogen, so that if with the 300 pounds of acid phosphate and the fifty pounds of muriate of potash there be mixed, say 350 pounds of cotton seed meal there would be obtained a fertilizer high in all the essential elements of plant food, a complete fertilizer for any non-leguminous crop.

The first consideration, therefore, is whether the crop be leguminous or non-leguminous. In this connection the effects, as determined in actual trials of a complete fertilizer, high in nitrogen and of a similar mixture but without nitrogen, on a crop of mixed clover and grass is extremely interesting. For example, suppose the acid phosphate, muriate of potash and cotton seed meal mixture referred to above, be used in late winter or early spring at the rate of, say 750 pounds to the acre, as a top dressing for clover and grass. What result would be expected? The growth of grass would be increased at the expense of the clover. In fact, heavy applications of such a fertilizer, by producing a very luxuriant growth of grass, may be used to crowd out the clover to a great extent. A practical application of this principle might be made to advantage on lawns where clover is not desired and where the expense of the fertilizer would be a trivial item. On the other hand, the acid phosphate and potash mixture, used above, would favor the clover at the expense of the grass. A judicious mixture of minerals and nitrogen would act favorably to increase the yields of both clover and grass without changing their relative proportions.

The second consideration in the rational use of fertilizers is one that would naturally be taken into account; namely, the value of the crop to be grown would have much to do with the quantity of fertilizer which could be profitably used. It is obvious that a $15-to-the-acre crop of wheat could not be profitably fertilized to the same extent as a $250-to-the-acre crop of onions. I mention this consideration in particular to emphasize the fact that the value of the crop limits the quantity of a fertilizer which can be profitably used, and not the fear of heavy applications "burning" the crop, as the saying is.

One year the month of May was so dry that, in many instances, early planted potatoes suffered severely for lack of moisture. In a series of fertilizer experiments, conducted at this time on a poor soil, only fourteen bushels of salable potatoes were harvested to the acre where no fertilizer had been used, while 116 bushels of salable potatoes to the acre were harvested on an adjoining plot fertilized with a high grade, complete fertilizer at the rate of about 1,200 pounds to the acre. Not only did this heavy application not "burn" the crop, but on the contrary it enabled the plants to resist the drought so that they remained green and vigorous long after the unfertilized plants were dead, and it produced an increase of over 100 bushels of salable potatoes to the acre. Market gardeners frequently use

1,500 to 2,000 pounds of fertilizer to the acre, and without fear of harmful results. There are at the same time possible conditions under which a fertilizer might shorten the yield. A soil very poor in nitrogen might be overfed with the mineral elements, phosphoric acid and potash, with the result that the corn or the wheat crop would starve for nitrogen, especially during a dry season. On the other hand, an oversupply of nitrogen is possible, so that a superabundance of stem and leaf may be produced at the expense of the grain. In either case, however, the shortening of the crop would be attributed more to the irrational use of the fertilizer than to any property belonging to fertilizers in general. Indeed, there are many reasons for believing that fertilizers, rightly used, help the plants to make the best use of the moisture supply. Different scientific observers in Germany, France and the United States have come to the conclusion that 500 to 600 pounds of water may be needed in order that a plant growing in a poor soil may produce one pound of dry matter, but that 250 to 300 pounds of water are necessary in the presence of an abundance of plant food. Here, then, is the explanation why the heavily fertilized potatoes stood the drought so much better than the unfertilized.

A third condition under which a fertilizer might do harm is when a high grade and quick acting fertilizer is used in direct contact with the seed, thus delaying or entirely preventing germination. This applies in particular to the present practice of drilling the fertilizer with the wheat. The injurious effect has been found to increase both with the lateness of the seeding and with the quantity of fertilizer used. Of all the fertilizer materials tested cotton seed meal was the most harmful; so that even 50 pounds to the acre drilled late in the season, in December, produced most serious consequences, while 100 pounds to the acre, drilled in October, restrained the growth of the wheat for weeks. The same effects, but to a less degree, were noticed for nitrate of soda, muriate of potash, and high grade tankage. This last material was drilled separately from the wheat, with the result that the germination of the wheat was not apparently affected, and clearly indicated the need of an improved grain and fertilizer drill, which would apply the fertilizer either beneath or to one side of the seed. Acid phosphate was the only material tested which exerted practically no retarding action on the germination of the seed. The present fertilizer drill is a serious drawback, therefore, to the use of both the best fertilizers and the most profitable amounts of the same unless the fertilizer be drilled at one time and the seed at another. A further warning is to avoid, during dry weather, heavy applications for grass.

After considering the requirements and the value of the crop the much more difficult problems concerning the particular deficiencies of the soil present themselves. Although a soil is never found which is entirely without any one of the necessary kinds of plant food, few soils are well supplied with them all, and much as the weakest link in a chain determines the strength of the chain, so the weakest—that is, the most deficient, element of plant food, whether lime, phosphoric acid, potash or nitrogen, determine the productiveness of the soil. The natrual question, therefore, is: What are the most deficient elements in the soils of Tennessee? Here chemistry comes to our assistance, and the chemical analysis has given us information of fundamental importance, so that rational systems of fertilizing for all the typical soils are made possible.

Let us recognize, first of all, two great classes of soils—bottom lands, which are overflowed every year or at least every few years; and uplands, which do not recieve deposits. Bottom lands are by no means all alike. They differ in texture from sand to stiff clay, but in general are well supplied with all forms of plant food, and constitute our most productive soils. Of uplands there are in East Tennessee at least five distinct types, three of which are found in the majority of the counties of East Tennessee. The first is the dolomite, of which the white, gravelly soils of such ridges as Black Oak in Knox County, and Boatman's in Hamblen County, are good examples. This soil is the most widely distributed of all, and covers the greatest area. The second soil in importance is the blue or Lenoir limestone. The third commonly occurring soil is the shale. In Middle Tennessee there are the naturally rich soils of the Central Basin and the naturally poor lands of the Highland Rim. In West Tennessee are the "flatwoods" soil, and various loams and sands which are not underlaid by rock as in the other sections of the State.

As shown by chemical analysis, the first and most important deficiency of all the uplands of the State in long cultivation, as compared with the virgin soil, is nitrogen; and with a deficiency of nitrogen is associated a deficiency of humus, which has a marked influence on the soil texture. How can the nitrogen supply be most economically increased? I would answer, by growing leguminous crops, both to be turned under and to be fed, and the manure returned to the land; and by the frequent putting of the land into pasture. With or without fertilizers we must look first of all to cow peas and to clover and grass to maintain and to increase soil fertility. Without these crops fertilizers can be used with only short-lived success, for at present prices the fertility of lands devoted to general farm crops cannot be permanently maintained with profit by the use of chemicals alone. Do the farmers understand the full value of cow peas? I think not. They understand that it is a valuable crop, a crop they would not like to do without, but they do not fully realize its vital importance as a restorer of nitrogen to the soil. One hundred pounds of cow pea hay contains as much nitrogen, which has been largely gathered from the air, as 100 pounds of the usual so-called high grade complete fertilizer. Grow peas with the corn and with the sorghum; grow peas after the wheat; grow late peas in the orchard and vineyard; grow peas in the melon patch, after it is laid by; grow peas many times over what they are grown now, and then I shall think the farmer is beginning to realize the value of the cow pea.

As shown by chemical analysis, the next important soil deficiency is phosphoric acid. This is a deficiency inherent in the soil, for phosphoric acid is not destroyed by the burning of the corn and cotton stalks as is nitrogen, neither is it wasted by leaching from the fallow land, or by escaping into the air. This natural deficiency, as shown by chemical analysis, is verified by the good results which follow the small amounts of 100 to 200 pounds of fertilizer used on the average soil devoted to wheat; for acid phosphate forms the body of pratically all wheat fertilizers, so that while in 100 pounds of the average complete fertilizer there is nitrogen and potash for only one bushel of wheat, there is phosphoric acid for fifteen bushels. Outside of the Central Basin, of Middle Tennesse, I do not consider any other fertilizer material to be of such importance as acid phosphate. With acid phosphate and cow peas, I believe that nearly all of our arable lands may be made both fertile and durable. Without phosphates—for there are valuable sources other than acid phosphates—I do not think this possible in the case of the white, gravelly soils of the dolomite formation in East Tennessee, the gray soils of the Highland Rim, or the soils of the Cumberland Plateau. The shale soils of East Tennessee, and the red soil of the Highland Rim and the uplands of West Tennessee come next in need of this element, while the blue limestone soils come last. Field experiments and chemical analysis indicate that here, also, the use of phosphates is advisable in many instances; in particular in East Tennessee, but only occasionally have the blue limestone soils of Middle Tennessee been found decidedly deficient.

The next practical question is, How much acid phosphate should be used? I would say not less than 200 pounds to the acre, and I would consider 300 pounds to the acre advisable for most crops, such as cow peas, clover and the like. Three hundred pounds means an excess over the amount removed by the crop. A rational system of fertilizing would be to continue the use of acid phosphate in excess until cow peas were no longer helped by it. This could be determined by always leaving a strip of land unfertilized with which to make the comparison. After the soil is built up to this point, which would probably require some years, can the use of acid phosphate be profitably discontinued? I answer, No. But only enough need be used to replace that sold off the farm. The amount would be small, about four pounds for each bushel of wheat or corn. The approximate amount can easily be gotten from tables showing the fertilizing ingredients contained in different crops.

The third soil deficiency, as shown by chemical analysis, is lime. The acid phosphate, which is nearly one-half sulphate of lime, would, when continually used, furnish a sufficient amount for plant food purposes, but of a kind that neither neutralizes soil acidity nor improves the texture of the soil. Therefore quicklime at the rate of, say forty bushels to the acre once in five years, is highly to be recommended. But the old adage should be kept in mind—

"Lime and marl without manure
Make both farm and farmer poor."

And I may add that the continued use of acid phosphate or of any commercial fertilizer, without the use of farmyard manure or of green manure, would have much the same effect, for the land in either case would be plundered of its nitrogen and humus.

For general farm crops potash seems to be the least needed element of plant food. The chemical analysis nearly always shows more potash than lime, often several times over. The clay soils of the blue limestone formation seem to be by far the best supplied with this element. The shale soils, the uplands of West Tennessee, and the red soil of the Highland Rim are moderately well supplied, while the white, gravelly soils and the soils of the Cumberland Plateau must be considered deficient. Here again cow peas can be used as an indicator. One strip can be fertilized with acid phosphate and another with a mixture of acid phosphate and muriate of potash. And if potash prove to be needed, it, too, should be used in excess each year along with the acid phosphate as long as good results follow. The amount needed to replace that which is sold off the farm is small, for there is only a comparatively small amount in the grain of cereals, and the potash in the straw and in the stalks of both corn and cotton would naturally be returned to the land. As a rule, I would not advise the use of more potash than is sold off the farm, an amount which, as in the case of phosphoric acid, can be determined from tables of analyses. Only on soils well supplied with the mineral elements, phosphoric acid, potash and lime, can such quick acting sources of nitrogen as sodium nitrate and ammonium sulphate be used with maximum advantage and effectiveness.

I think that a careful study of the subject will show that the rational use of fertilizers has little to do with cut and dried formulas, but depends much more on a clear understanding of the principles concerned in the use of the different kinds of plant food. The subject demands much thought along with the reading and study of books and papers and with experiments in the field. I do not, however, say that fertilizer formulas are worthless; on the contrary, they have a place, but a limited and subordinate one. In addition, I believe that the fertilizer mixtures now sold on the market are apt to be used with profit. The present retail prices of all fertilizers are high. Without doubt money can be saved by farmers combining so as to get car load lots at wholesale rates. Moreover, the different materials can be bought at retail and mixed at home at a good profit. In addition to the saving of money, the home mixing of fertilizers helps insure the purchaser against fraud and the different materials bought unmixed would be an incentive to field experiments, and would lead finally to a better use of money thus invested.

SELECTING AND IMPROVING CORN.

By Prof. Andrew M. Soule,
Director Tennessee Experiment Station.

CORN constitutes one of the most important crops of the American farmer. It is more largely used for the maintenance of man and beast than any other cereal, and when manufactured, many very important and useful by-products are obtained. The corn crop of the United States for 1902 was estimated at 2,500,000,000 bushels, worth over $1,000,000,000. This immense crop was produced on 94,000,000 acres of land, so that the average yield obtained was 26.5 bushels per acre. The yield is very small indeed; in fact, it is not uncommon for corn to yield from fifty to 100 bushels per acre, and it is authentically stated that 254 bushels of corn were produced on a single acre of land in South Carolina. These statements indicate that it would be possible to double the yield of corn in the United States on the area of land now cultivated by giving greater care to the selection of the seed and the cultivation of the soil. This would put another billion dollars in the pockets of the American farmer, and as by far the larger portion of it would be clear profit, the importance of giving more careful attention to the selection and improvement of corn is evident.

Tennesee's interest in the corn crop is a very large one, for of the total area devoted to cereals, in 1899, 66.7 per cent was cultivated in corn. In that year 3,374,574 acres were devoted to the culture of corn, and the yield obtained was 67,307,390 bushels; the value of the crop was $28,-

059,508, and as the total revenue from all farm crops in 1899 was $70,745,242, corn produced more than one-third of that amount. The average yield of corn per acre in Tennessee, in 1899, was twenty bushels per acre; in 1900, twenty bushels; in 1901, 14.2 bushels. The falling off in 1901 was due to the severe drought which prevailed that year. In 1902 the corn of the State, on about the area usually cultivated, is reported to have been approximately 80,000,000 bushels. The highest yield per acre recorded in the last ten years was twenty-six bushels per acre, while the average for that period was but little more than twenty-one bushels.

Assuming that the acreage of corn in Tennessee in 1902 was 3,374,574 acres, an increase of one bushel per acre would mean 3,374,574 bushels, which, at a value of 50 cents per bushel, would be worth $1,687,287. Assuming that the yield could be increased five bushels per acre, the increased yield would amount to 16,872,870, which, at 50 cents per bushel, would represent a money value of $8,436,435. Those who have studied the culture of corn carefully know very well that an increased yield of five bushels per acre could be obtained, and in view of the large money value it would represent, there is every reason why the farmer should put forth the greatest effort to increase the yield of his corn crop, especially as he can do so with a comparatively small outlay of cash.

Allowing 100 ears to make one bushel of corn, and assuming that the field is planted in hills 3 feet 6 inches apart, it is apparent that there would be 4,000 hills and 8,000 stalks per acre. If the ears obtained numbered 2,100, evidently 5,900 stalks on the acre of land were barren. If only one stalk per hill were left there would still be 1,900 barren stalks. Few persons realize what a large number of stalks of corn fail to produce ears, and this is one reason why the yield of corn remains low in many sections of the country where the natural conditions are favorable to the production of large crops. The difficulty can be easily remedied, and is one of vital importance to the farmer; for, as a matter of fact, he should obtain a good ear from every stalk in the field.

On the University farm, in 1902, where the corn was planted as indicated above, two stalks being left per hill, White Rockdale produced 9,500 ears, or considerably more than one ear per stalk; Cocke's Prolific produced 9,250, and Blount's Prolific, 9,100. The smallest number of ears was yielded by Mexican June corn, 4,150, which was not surprising, as it does not seem to be well adapted to our climate. Shaw's Improved, a very large, vigorous river bottom type of corn, grown on our medium uplands, yielded 6,600 ears from 8,000 stalks. These statistics bring out very clearly the importance of destroying all barren stalks, for if the ears of the growing corn are fertilized by the pollen from these stalks the corn taken from these ears and grown for seed has a tendency to produce barren stalks. Careful attention to this point will be sure to result in an increased yield.

The preparation and cultivation of the soil is also a determining factor in increasing the yield of corn. Many persons grow corn on land year after year, failing to rotate crops or to replenish the supply of vegetable matter in the soil. Corn loves a deep, warm, porous soil, and so the land should be plowed deeply and carefully subsoiled. A fine seed bed should be prepared and the land should be enriched by a liberal coating of farmyard manure, well worked in as a top dressing, or else by the plowing under of a crop of clover or cow peas every second or third year. If greater attention were given to maintaining the fertility of the soil and keeping it in proper mechanical condition, there would be less complaint of small yields of corn.

It is not the purpose of this paper to discuss soil culture, as related to crop production, and so further reference to the subject will be omitted, but soil cultivation is so very important and so frequently neglected that it is deemed advisable to at least refer to it in passing. The thorough and persistent cultivation of corn lands is as essential to increasing the yield and quality of the crop as the matter of seed selection or the destruction of the barren plants, and though the subject of soil cultivation is a very old one very few people thoroughly appreciate its importance.

The selection of seed corn, to be successful, must be undertaken in a systematic manner. Slip-shod work will only result in failure and disappointment. The best results will be obtained by preparing and enriching a piece of land with extra care for the seed patch. On this land the grain obtained from selected ears, as described further on, should be planted, a single row being devoted to the grain from each ear. The rows should be about 3½ to 4 feet apart, and the grain may be planted in hills or drills, as deemed preferable. When planted in hills about two stalks per hill should be left, except in the case of the larger river bottom types, and when planted in drills the grain should be placed about one foot apart in the rows. The choicest and best ears should be planted near the center of the patch and the poor ones on the outside. The butts and tips of all the ears should be carefully shelled off before planting, and these may be seeded in several rows on the outside of the plot to protect it from admixture with foreign pollen from corn in neighboring fields. The seed plat should, of course, be isolated as much as possible; at least eighty or 100 rods from any other field of corn, and even then there is some danger of cross fertilization, as the pollen of the plant is very abundant and is carried a long distance by the wind. By planting the patch, as suggested, a record can be kept of the product of each ear of corn with but little expense or trouble, and the following year the seed can be selected from the choicest and most vigorous individual plants.

The most rapid progress will be made by seeking out and improving the choicest individual plants and ears, and, therefore, if one is to gain anything from the special seed patch a careful record must be preserved of the individual ears and plants, or the results obtained will fall short of what might be accomplished by the exercise of greater care and vigilance. The special seed patch is an essential part of the work of corn selection, and will require the expenditure of but little money, time or effort on the part of the farmer. Certainly the outlay will not be at all commensurate with the increased yield of corn which he should obtain.

At this juncture many persons will be wondering whether selection will pay or not. This question can be answered in several ways. There is an old axiom which says, "Eternal vigilance is the price of success," which might be appropriately taken as the motto of the corn breeder. Will it pay to select seed corn? Who would ask the question when he stops to consider that one bushel of well selected corn will plant ten acres, which ought to produce 400 bushels of corn, worth anywhere from $160 to $200 per acre. A bushel of seed corn has been known to return 700 bushels at the next harvest which, on the same basis, would represent a money value of $350 per acre. The cost of a bushel of improved seed corn may be two dollars, and many a man thinks because he can buy it for fifty cents a bushel that he is wasting a dollar and a half. He does not look far enough ahead to realize how vitally the seed will influence the yield, and hence the profits to be derived from his crop. He is often quite willing to spend his best time and effort in the preparation and fertilization of his soil, though not willing to pay a good price for the highest quality of seed to put on his land. What folly; what a waste of human energy; how short-sighted on the part of the farmer!

Selection which has resulted in obtaining good seed has been known to increase the yield of corn from five to twenty-five bushels per acre. These facts make it evident that good seed is of the utmost importance, and as this good seed can only be obtained through selection it is to the interest of the farmer to give attention to such an important matter at once. If he has not the seed, let him pay a good price to some reliable party who can furnish him with some thoroughbred corn, that has well established desirable hereditary characteristics, and that can transmit these to succeeding crops. Few persons now question the value of thoroughbred stock, and there are few persons but realize that selection must be practiced in the animal kingdom if success is to be obtained in animal breeding. As the same laws apply to the plant world, why should there be any hesitation in making the application? why need there be a doubt in the farmer's mind as to the advisability of practicing seed selection? The laws of nature hold in all the different phases of life. Animal breeding has been practiced for several hundred years with more or less success. Plant breeding is a comparatively new industry, and hence it strikes many people as a fad—as a newfangled idea. These conclusions are eminently wrong. The only way to judge of the question fairly is on its merits, and these, when fairly considered, will carry their own conviction.

The question naturally following is how to go about seed selection. The farmer who has given no attention to the subject can possibly afford to buy his seed for the first year, but not after that. No person can grow as good seed for the farmer as he can produce himself, and certainly when he finds it necessary to purchase seed he should not have to go far from home. People say seed "runs out;" they say a change of seed is necessary; they say they must bring in new varieties from a long distance in order to increase the vigor. All these things are untrue. Seeds run out because they do not receive the care and attention on the average farm that the originator gave them in their process of development, and hence they revert and lose the special qualities that gave them their peculiar value. Corn has been grown on the same farm and the same land for years and years, and has gradually improved throughout the whole period. Notable examples of this are found in the case of Boone County White, developed by Mr. Riley, of Thornton, Ind., and Early Leaming, developed by Mr. J. S. Leaming, of Wilmington, Ohio. Mr. Riley commenced his improvement of corn about 1875, and Mr. Leaming in 1825. Thus it is that these two varieties, through the intelligent selection of these gentlemen, have become two of the standard varieties of the great corn belt. Their qualities are better known and more highly esteemed today than ever before, showing the importance of systematic selection where a definite idea is kept in view and the work persistently carried on through a long series of years. These two gentlemen were ordinary farmers, and their example should prove a beacon light to many others. The results obtained by them are sufficient to answer all the questions that so easily arise in the mind of the croaker.

The farmer should produce his own seed corn because it is a needless expense to purchase fresh seed every year, and when once he obtains a variety adapted to his soil and climatic conditions it will give a larger yield and prove more satisfactory if he selects it so as to keep the type uniform and the quality and yield up to a certain standard than fresh seed of unknown origin. Probably it is more important that the farmer produce his own corn seed than that of almost any crop he grows, because the plant is so susceptible to climatic influences. Notice the difference in the characteristics of corn produced in the semi-tropical regions as compared with that growing in Minnesota. In the tropics the stalk is enormous, and under irrigation in Mexico often three to five large ears are obtained and the stalks frequently reach a height of eighteen to twenty-two feet. In Minnesota, on the other hand, the ears are small and the stalk not more than five to eight feet high. Observe that a well-established variety of river bottom corn, such as the Huffman, when grown on uplands frequently proves unsatisfactory. The studious farmer has also noted that the variety of corn that does well on his neighbor's farm does not give as good satisfaction on his. He has also observed that corn brought from Iowa into Tennessee or even from Ohio, does not do well the first year, though it may do better the second and third. On the other hand, he has sometimes observed that corn brought from neighboring states and counties is an utter failure. All these things teach as plainly as nature can indicate that the farmer should pay attention to the selection and development of corn for his own locality and for his specific needs. As corn is easily selected and preserved, there is no reason why the farmer should not become his own seedsman, and so save his pocketbook from the extortion of unscrupulous dealers who are only too glad to send him some old variety of corn of uncertain origin and value under some glowing new name at a fancy price. Thousands of dollars are annually squandered in the purchase of seed corn of no value to our farmers, nor is this the worst feature of the case, as the seed purchased is often inferior.

Having obtained some seed well suited to his locality, either by purchase from his neighbor or from some reliable seedsman, he should prepare at least one section of his field carefully for the production of seed the following year. When the corn is coming up it should be run over two or three times with the weeder, and later with a two-horse cultivator. An implement of the Tower type is very satisfactory for the purpose. It is a strictly surface cultivator, and it has been shown time and again that deep cultivation of corn is a mistake, especially after the first cultivation. Deep cultivation is unnecessary if the seed bed has been properly prepared. The slovenly farmer is the only one who believes that deep cultivation is essential, and his mistaken notion arises from his failure to cultivate the land properly before planting the corn. In other words, deep cultivation is like trying to put the cart before the horse—to do that after the crop is up which should have been done before the planting. Let the cultivation be persistent; keep it up. When the corn gets so high that a two-horse cultivator can no longer be used, use a single cultivator of the Planet, Jr., or Iron Age type. By muzzling the horse the corn can be cultivated until it is out in full silk and tassel if necessary. By doing this the moisture will be retained in the ground and the plants kept in full health and vigor, and this point cannot be emphasized too strongly, for let it be remembered that it is individual excellence we are after that can only be secured through the most careful cultivation. As soon as the corn begins to flower go carefully through the field and destroy the tassels of all plants that are barren, so that the pollen from these will not fertilize the silks of productive plants. Make sure that the detasseling is done before the pollen forms. The corn plant should also be carefully suckered, not more than two plants should be allowed to remain in a hill, and any plants showing evidences of smut should be pulled up and destroyed.

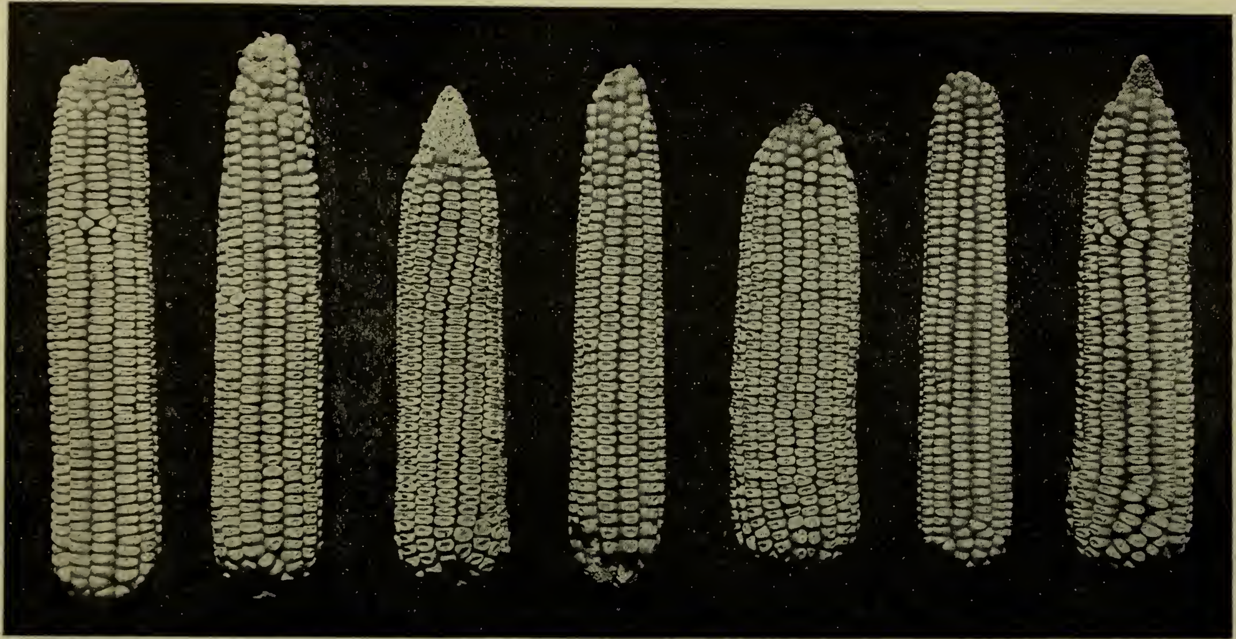
Throughout the growing season the farmer should pay frequent visits to the corn field, so that he may study the individual plants and select those that show special vigor and the desirable characteristics he wishes to perpetuate. This study of the growing plants is a very important matter, for one cannot always rely with any degree of certainty on going into the field in the autumn and picking out the great big ears from the big coarse plants. To succeed in selecting corn one must study the individuals closely in order to be able to make fine distinctions, for it is this ability that measures the success of the artist in any line, and quite as much the case of corn breeding as in any other pursuit.

Having made a previous study of the plants, when harvest time arrives the farmer is ready to go into the field and make an intelligent selection from the stalk showing the characteristics he prefers and bearing ears of the type he has set up as his ideal. Of course a standard is essential, which means that the farmer must determine whether he wants a very large, coarse stalk with the ear high from the ground, or a small, stout stalk with the ear set on lower down; whether he wants a very large, coarse-grained ear or a medium-sized compact one closely packed with flinty, wedge-shaped grains. A word of warning may be advisable here. It is always a mistake to select from abnormal plants or animals. Such selection increases the tendency to variation, and when carried to excess results in the development of undesirable qualities, increases the tendency to disease, and produces an abnormally coarse product. On the other hand, selection from too small stalks would result in a loss of vigor. Do not choose from either one of these extremes; the happy medium is much better and safer, and will give far more satisfactory results in the end.

Select the ears from stout, healthy stalks that have made a uniform growth throughout the season and that are well provided with leaves so as to furnish plenty of fodder. Be sure that the tassel of the plant is strong and vigorous, and that it is free from any evidences of disease. See that it is an upright growing plant and firmly rooted in the soil.

Two methods of selecting ears will present themselves, and the farmer must choose which he deems best for his locality. He may either select one good-sized ear from a stalk, or two medium-sized ears. By selecting two medium-sized ears he will obtain larger yields in the long run, though he may have to follow up his practice several years before getting the hoped-for results. In either case the type of ear selected should possess the same qualities save for size only. Select only ears that are well silked, that have a good covering of husk coming well over the tip. An excessive amount of husk is, of course, objectionable, as it indicates coarseness. The shank bearing the ear should be short and not over an inch or an inch and a quarter in diameter, and the ears should point downward. The number of rows of grain on the ear will vary with the variety, but in nearly all standard varieties they run from sixteen to twenty or even twenty-four. In a few varieties it may run as low as twelve, but sixteen or over is a fair average. The rows should be straight from tip to tip and uniform—that is, the grains should not be deeper and wider at the butt than at the tip. This means that the cob must be uniform in circumference at the tip and butt and that it must be perfectly straight. The grains should be rather wedge-shaped, though not too long, and if it is a white dent corn, they should be a pure white on a white cob and flinty in texture, though not extremely hard. The tip of the ear should be perfectly covered with corn as well as the butt—that is, the grains around the butt should form in close around its attachment to the shank. Too much stress should not be placed on the development of the tip and butt, as this point is frequently overdone. While it is true the tendency to fill out is transmitted, the season and the cultivation have a great deal to do with the development of a perfect ear, and as fertilization of the ear begins at the butt, weather conditions, as drought and violent wind storms, may injure the vitality of the pollen, and hence the flowers on the tip of the ear will not be properly fertilized, which accounts for their failure to develop.

After making the choice with these points in mind the selected ears should each be carefully marked and labeled, and carried directly to the house where they can be securely stored in a rat-proof room of uniform temperature. A temperature of fifty degrees to seventy degrees will be most satisfactory. When time permits the ears should be husked and placed on racks where they will dry uniformly. In



VARIATION IN EARS OF COCKE'S PROLIFIC.—Left to right: Well developed; too tapering; rows lost at top; not well filled at tip or butt; too short for circumference; too long for circumference; too open.

the spring, early in February or March, a few grains should be picked from different parts of the ear and placed in sheets of moist blotting paper and put in an ordinary cigar box to determine their germinating power. The difference in the germinating power of grains from several ears is often quite surprising and only seed should be saved for planting from those which show special vigor. When the best ears have been selected they should be further examined by making a physical examination of a number of grains selected from different parts of the ear.

The following germination tests with corn show the great importance of making the examinations referred to before planting, and also of selecting grains that are of uniform size and shape in order that large and well developed germs may be obtained. The germinating power of the several varieties indicated as "sample bought," varied from seventy-seven to ninety-eight per cent in a test covering a period of seventy-two hours. In other words, more than twenty per cent more grains germinated in the case of Blount's Prolific than with Leaming. Under these circumstances, to secure a perfect stand with Leaming would require the purchase and seeding of one-fifth more grains than in the case of Blount's Prolific. Notice that in the case of deformed grains from Cocke's Prolific only twenty-seven per cent germinated, whereas with ideal grains the number was ninety-two. Fifty-three per cent of the butt grains of Cocke's Prolific germinated, and seventy-four per cent of the tip grains, showing that the stand and yield of corn obtained may be influenced very considerably by the size and shape of the grains selected.

Germination Tests with Corn.

VARIETY.	Kind of Grains Used.	Per Cent Germination—72 hours.
Golden Beauty	Sample bought	92
Early Mastodon	Sample bought	87
Leaming	Sample bought	77
Snow White Dent	Sample bought	94
Blount's Prolific	Sample bought	98
Cocke's Prolific	Tip grains	74
Cocke's Prolific	Butt grains	53
Huffman	Ideal grains	92
Shaws Improved	Soft corn	86
Huffman	Flint corn	95
Cocke's Prolific	Deformed grains	27

It is important that the grains planted be obtained from the middle of the ears so as to secure those of as nearly uniform size as possible. Those who have not studied the question carefully may think this statement far-fetched, but it is only necessary to examine the following planter tests to be convinced of its importance. The grains shelled from the cobs just as they come, and including the deformed grains as well as those from tip and butt, could hardly be expected to give a uniform stand, as the planter tests show, whereas, if the deep grains were selected there would be much less thinning to do by hand or with the hoe and a more uniform stand and better yield would be obtained.

Planter Tests—50 Drops.

1. The *whole ear* was shelled and planted:

    No kernels, 4 times.
    1 kernel, 30 times.
    2 kernels, 16 times.

2. Only the *tip* and *butt* kernels were used:

    No kernels, 2 times.
    1 kernel, 18 times.
    2 kernels, 19 times.
    3 kernels, 8 times.
    4 kernels, 3 times.

3. Only grains taken from the *middle* were used:

    No kernels, 10 times.
    1 kernel, 29 times.
    2 kernels, 10 times.
    3 kernels, 1 time.

4. *Deep grains* only were used:

    No kernels, 1 time.
    1 kernel 44 times.
    2 kernels, 4 times.
    3 kernels, 1 time.

5. Only *shallow grains* were used:

    No kernels, 6 times.
    1 kernel, 39 times.
    2 kernels, 5 times.

Aside from the hull which surrounds the kernel there are three principal parts to a kernel of corn. First, a hard, horny layer lying next to the hull, chiefly at the tip end and along the sides of the kernel. This substance constitutes about sixty-five per cent of the corn kernel, and contains a large part of the total protein in the kernel. Next to the horny layer is a white starchy substance occupying the crown end of the kernel and producing what is commonly known as cornstarch. The germ occupies the central part of the kernel lying well towards the tip end. It constitutes about ten per cent of the kernel, and while it contains a high per cent of protein it is especially rich in oil, often showing more than eighty-five per cent of that substance.

Thus it appears that the kernel showing a large amount of horny matter and a large, vigorous germ will be richest in portein and lowest in starch. Corn, as is well known, is a carbohydrate food—that is, it is chiefly valuable for the production of fat. It is a poorly balanced food, and in order to obtain the best results in feeding must be combined with some other grain. It therefore becomes an interesting and important matter to the farmer to increase the portein content of the grain so as to make it a better balanced food. Of course there are circumstances under which it would be desirable to increase the starch content which could be readily done through the medium of selection.

After selecting grains as suggested and making a physical examination of these by making cross sections and splitting them open, the relative amount of starch and portein contained in the grains can be quite readily determined; so readily, in fact, that it would be easily possible to increase the portein or starch content of the grains through the medium of a physical selection. In fact, this has already been accomplished at the Illinois Experiment Station. After examining the grains from the different ears and determining which method of selection is preferable for his individual needs, the farmer can discard either the grains showing the high portein or the high starch content. Having tested his seed and made the physical examination indicated, he is ready to go ahead with his planting. The method he should pursue in the planting of his special seed patch and the care and treatment of the same have already been carefully outlined.

In this connection it will not be out of place to call attention to the importance of selecting a variety well adapted to local conditions for improvement through selection. The importance of securing a standard variety is brought out by the figures set forth in the following table, which gives the yield of the leading varieties grown on the university farm in a dry year and a favorable year, and the average for both years. Notice that there was a decided difference in the yield for the two years; that some varieties which were among the leaders in 1901 were not represented in 1902, while others which were not represented in 1901 and 1902 had a better average for both years. The mistake is sometimes made of selecting a variety that has been tested only once in a community and given satisfactory results in place of selecting one that has been thoroughly tested. The soil situation and season must both be considered in making the choice of a variety with which to commence work, as certain varieties will give satisfaction on dry uplands and be a failure on rich river bottoms.

Variations in Corn, 1901–1902.

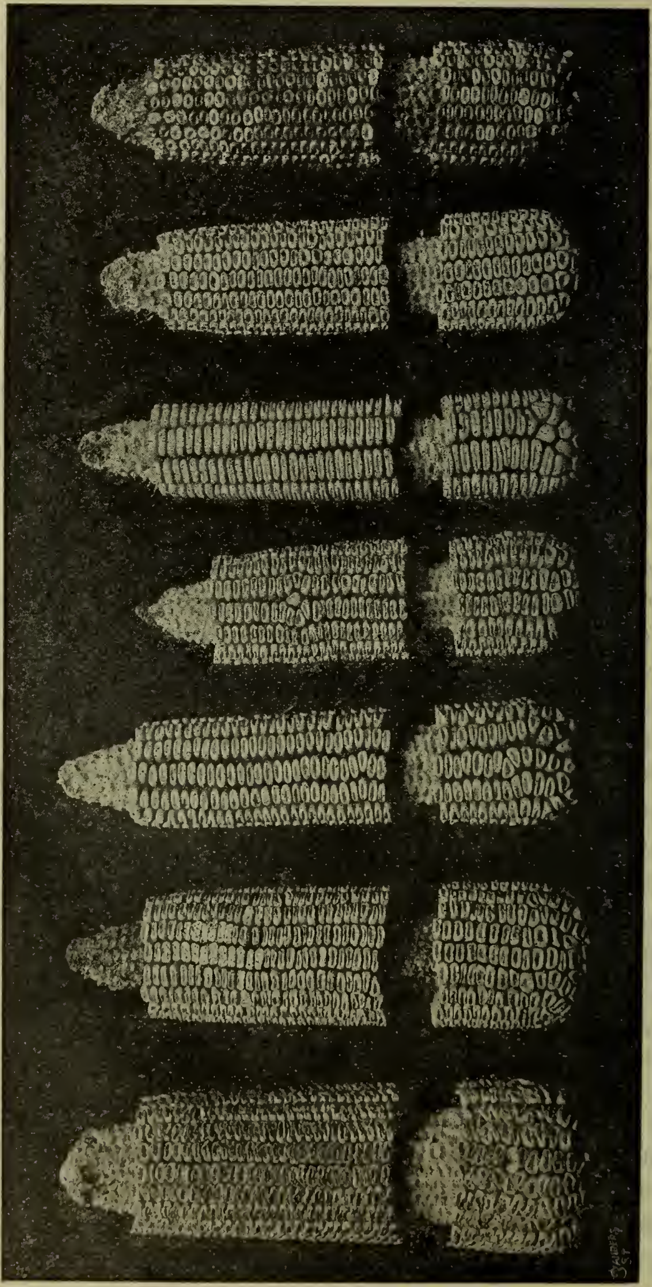
	NAMES OF VARIETIES.	No. of days maturing.	Height of crop—inches.	Weight of Green crop—tons.	Yield of grain per acre—bus.	Per cent of grain in green crop.	Weight of dry ears per bus. of grain—lbs.	Per cent of cobs in dry ears.
	EXPERIMENT IN 1901—DRY YEAR.							
Best.	Hickory King	117	112	8.35	38.39	12.87	64.77	13.53
	Iowa Gold Mine	103	96	5.63	35.95	17.89	66.88	15.75
	New Klondike	113	108	6.94	34.82	14.06	65.33	17.22
Medium.	Wis. Early White Dent	103	92	6.30	22.32	9.92	67.70	17.29
	Pride of Nishna	110	100	7.15	21.43	8.39	67.92	17.44
	Golden Beauty	113	106	7.20	20.53	7.99	69.73	19.58
Poorest.	Huffman	132	115	9.93	8.93	2.52	74.79	24.76
	Compton's Early.	96	62	1.78	6.25	9.86	85.24	34.14
	No. 4568	132	87	6.25	4.91	2.20	72.33	22.50
	EXPERIMENT IN 1902—FAVORABLE YEAR.							
Best.	Huffman	128	136	13.53	59.48	12.26	66.88	16.25
	Osbourne	119	129	11.90	58.48	13.74	66.30	15.53
	Cocke's Prolific	114	129	11.95	56.92	13.33	69.50	19.42
Medium.	Best of All	99	86	6.58	43.53	18.53	66.20	15.41
	Large W'ite Flint	106	107	9.90	40.28	11.42	77.89	29.00
	Yellow Creole	129	149	12.80	39.73	8.68	70.75	20.85
Poorest.	White Cap Yellow Dent	99	85	5.80	35.71	17.26	67.73	17.30
	Egyptian	101	85	7.25	27.23	10.52	70.90	21.02
	Mexican June	125	139	11.85	21.43	5.07	70.26	20.29

AVERAGES FOR 1901–1902.

Best.	Hickory King	114	113	9.35	44.09	13.18	64.77	13.54
	Iowa Gold Mine	101	93	6.87	42.31	17.41	65.94	14.81
	Ch'pion W. Pearl	103	99	7.87	41.41	14.43	67.07	16.46
Medium.	White Rockdale	125	118	9.82	34.88	9.18	66 11	15.19
	Huffman	130	126	11.73	34.21	7.39	70 84	20.51
	Wild Goose	120	120	10.67	32.93	8.13	69 21	18.94
Poorest.	Yellow Creole	129	134	10.37	25.67	6.39	75.63	25.58
	Large W'ite Flint	112	98	8.07	25.50	8.12	77.45	28.11
	Mexican June	127	120	9.52	21.77	6.84	70.58	20.63

There is one matter with regard to selecting corn for southern conditions that has not been touched on that is of more than passing importance. As we traverse southward the sun's rays become more direct and the heat greater. The increased amount of sunlight has a tendency to make the corn plant grow taller, and hence in the South it is not uncommon to find giant varieties of corn, and in order to get fair yields it is necessary to plant them long distances apart, frequently four and five feet. Open planting lets in more sunlight and still further increases the tendency to an abnormal development of stalk. The larger the stalk of the corn plant the greater the development of an undue amount of cellulose and crude fiber, which makes the plant more indigestible and reduces its feeding value. The idea of many farmers is evidently to see how large a stalk and ear they can obtain. Is not this a mistake? Would it not be better to select corn with the idea of keeping the stalks of medium height, say eight to ten feet, so that two stalks could be left to mature in hills three and one-half feet apart each way? Would it not be better to strive to have one or two medium-size ears on these stalks and increase their number rather than have one very large, coarse ear on a mammoth stalk occupying one-third to one-half more ground? The larger yields of corn obtained in the North are not from an increased size of ear and not from the development of unusually large stalks, but from the thickness of the planting which their climatic conditions favor. It is the opinion of the writer that by selecting corn with the idea of obtaining a medium stalk so that thicker planting could be pursued the yield of corn could be materially increased in the South. In fact, the experiments conducted on the station farm with this object in view tend to strengthen this belief. Surely this is a problem of vital importance to the Southern farmer. By reducing the size of the stalk he can decrease the amount of cellulose and crude fiber it contains, increasing both its feeding value and the yield of corn.

Our method of selection in the past has been dictated by climatic conditions. There has been an idea in the minds of many farmers that unless corn was planted far apart and great stalks and ears developed that the crop was an indifferent one. Some years ago when living in Texas the writer saw the corn crop of the State virtually destroyed by means of a hot wave. It was as bright and beautiful in the evening as corn fields ever get to be and by the next night was cooked almost as thoroughly as if put in a furnace. As a result train loads of seed corn came into the State the next year, much of it from Iowa. True the distance it was brought was too great, but circumstances made it necessary. This corn, when planted, produced little spindling stalks that were not more than five or seven feet high. It looked as though the crop was an entire failure, and yet to the surprise of all who witnessed it, it made a larger yield than some of the staple varieties that had been cultivated in the State for a number of years. As it was, the yield could have been considerably increased by planting the stalks closer together. This is an important matter, and one worthy of consideration by every Southern farmer. The basis of our selection in the past seems faulty, and we should endeavor to correct those defects in our corn, which the climate seems to foster, if we are to increase our yields as much as it seems possible for us to do, and at the same time obtain a better quality of fodder.



SEVERAL LEADING VARIETIES OF CORN, showing size of cob and depth of grains.—Left to right: Shaw's Improved, Huffman, Cocke's Prolific, Virginia Ensilage, Hickory King, Champion White Pearl, Early Leaming.

To facilitate the development of selection standards for corn have been established and a score card constructed. That in use at the Tennessee College of Agriculture is as follows:

POINTS.	PERFECT SCORE.	EXPLANATION.
Uniformity of exhibit	10	Uniform in characteristics and true to variety represented.
Shape of ears	5	Tapering from butt to tip; cylindrical.
Color of ears	10	Yellow corn, reb cob; white corn, white cob.
Market condition	5	Ears sound, firm, free from mold, etc.
Tip of ears	10	Not too tapering and filled with regular rows of kernels.
Butts of ears	5	Kernels in regular order over butt; open and swelled butts objectionable.
Uniformity of kernels	5	Uniform in size, color and shape and true to variety.
Shape of kernels	5	Wedge-shaped.
Length of ear	10	Should conform to standard of variety.
Circumference of ear	5	Should conform to standard of variety.
Space between rows	10	Space between rows small.
Per cent of corn	20	Proportion of corn to cob determined by weight.
	100	

The values given for the possession of certain qualities and the characteristics the ears should possess in order to approach the standard will be apparent from a perusal of the table. By adopting a standard, such as this, the farmer can soon become fairly skillful in the judging of corn, and he can soon bring his own product to the point where it will approximate the desirable qualities indicated by the standard.

It is very evident from these facts that the farmer should give more attention to the subject of corn breeding and improvement. It is congenial work and it is profitable work. The field is new, the harvest will fall into the hands of the progressive few—men who are far-sighted enough to establish varieties of corn specifically adapted to Southern conditions, and by rigorous selection maintain their qualities through an indefinite period. The field is certainly an attractive one, and the demand for seed corn is so great that corn breeding will prove a lucrative business for many years to come. The process of selection is so simple that all can participate in the benefits to be derived from an improvement of seed corn.

THE PRODUCTION AND FEEDING OF SILAGE TO BEEF CATTLE.

By Prof. Andrew M. Soule,

Director Tennessee Experiment Station.

WHERE you find an abundance of cheap land and much of it unfenced cattle can be grown very cheaply, as they require but little care, and in the eyes of the owner cost him nothing. As the winter feeding of cattle requires a decided change in the management, entails more labor, and the mastering of a new set of problems in order that the feeding may be accomplished economically and at a profit to the owner, it is no wonder that men of the older school have not given more attention to the finishing of the beef cattle produced in the South. It is a fact that comparatively few of the stockers grown in the South are finished, and so they do not bring more than one-half or two-thirds as much money as they would in a well fattened condition.

It has been believed for many years that cattle could not be profitably fattened in the South in spite of the fact that there has been an abundance of the cheapest and best concentrate for that purpose produced within its home territory. This idea arose from several causes: First, the belief that the major portion of a ration must consist of corn in order to produce good beef; second, from the belief that not enough grass could be raised in the South; third, because of the unfortunate experience of many feeders with silage at an early date when less was known about the construction of silos and the handling and management of the crop to insure the preservation of the food in the most palatable and useful form.

It is needless to say that many choice grasses can be produced in the South, and that those farmers who believe the South cannot finish stockers because of a deficiency in grazing crops are certainly in error. It is true that blue grass may never be successfully raised on an extensive scale in several of the Southern States, but it is well to remember that there are other grasses which may be substituted successfully for blue grass. For instance, there is Bermuda, which fully compensates for blue grass in sections where the latter will not grow. Then tall oat grass, orchard grass, red top, and the clovers can be grown more or less successfully in almost every Southern State, and these grasses, being peculiarly adapted to our Southern climatic conditions, will furnish the needed grasses once they are properly utilized.

It is not the purpose of the present paper to discuss the grazing problem, but it has been deemed necessary to refer to it in passing for fear the reader might be led to think that grass could not be successfully grown. To the mind of the writer the South is essentially a forage crop country. In no section of the United States does a greater variety of forage crops of high feeding value thrive more luxuriantly than in the South. The leading crops are so familiar that it hardly seems necessary to enumerate them, including as they do, Indian corn, sorghum, Kafir corn, soy beans, and cow peas. These crops, when receiving rational treatment and grown under a rotation which enables their combination to the best advantage, can be utilized for the production of a vast amount of cheap hay, silage, or grain for the winter feeding of beef cattle. And the growing season is so long it makes but little difference whether the season be hot or cold, wet or dry. There is always sufficient time and enough rainfall to insure the production of a large crop of feed from one or more of these hardy and vigorous growing forage crops, and it is in this sense that the South must be regarded as essentially a forage crop country, for these crops can be relied on and of necessity constitute the main dependence of the farmer. As they yield freely and can be produced with a reasonable amount of labor, the question of interest to the feeder is to what extent they can be utilized as winter feed for the production of beef.

Two problems in cattle feeding now present themselves, always provided, of course, that stockers can be purchased in the vicinity where the feeding is to be carried on. This should not be a serious problem, as practically all the cattle produced in the South today are sold as stockers, and the strangest part of this strange business is found in the fact that these stockers, for the most part, go to Virginia, Kentucky, and other Southern States for winter feeding where the natural conditions and the crops produced are not as favorable as where the cattle are grown. If these feeders can buy the cattle and transport them such long distances by rail and then feed or graze them without enjoying the advantages which the farmers in the stations lying south of them possess, there is certainly no reason why the cattle should not be successfully fed in the home territory.

The problems confronting the man who proposes to feed cattle during the winter may be briefly stated as follows: First, as to whether it is advisable and profitable to put cattle weighing about eight hundred pounds on feed about the first of November and force feed them for 150 to 180 days with the idea of finishing them for immediate slaughter; or whether it is better to feed them on a light ration for 150 to 180 days and finish them on grass the next spring and summer.

In order to show the value of the many forage crops that can be grown in the South, and also to determine as far as possible the true status of silage from corn and sorghum for feeding to beef cattle, the Tennessee Experiment Station commenced last year a rather comprehensive experiment with the objects set forth in view. Thirty-two head of cattle were used in these trials. They were of fair quality and would probably be termed Shorthorn grades, as that blood predominated. They were obtained within a few miles of the station through the assistance of local feeders. It was deemed advisable to get cattle from as near home as possible in order that the investigations would be thoroughly practical and the results applicable to the conditions confronting the farmer. While larger gains might possibly be made with a better grade of cattle, it would certainly be inadvisable to use animals brought from a considerable distance, as the experiment, if successful, would then be of little service to the people.

The first sixteen of these cattle were divided into four groups of four each and placed on feed the first of November and fed for 150 days. All these groups received sorghum silage as roughness. Commencing with thirty pounds it was gradually increased to forty, though it naturally fell off to about thirty towards the end of the feeding experiment. The animals, when first placed on feed, received only about four pounds of meal; this was gradually increased at the rate of about a half a pound a week for the first thirteen weeks, when it reached the maximum fed—about twelve ponds per head per day. It was maintained at this rate during the last eight weeks of the feeding experiment. By increasing the meal ration at the rate suggested, uniform gains were made from the beginning to the end of the experiment. It has been thought by many that when cattle were fed silage they would make enormous gains for the first few days and would then fall off, but this did not prove to be the case.

Table I.—Gain in Weight of Feeders.

GROUP.	WEIGHT.		GAIN.	
	Initial Lbs.	Final Lbs.	Total Lbs.	Daily Lbs.
XI	3,290	4,732	1,442	2.40
XII	3,325	4,612	1,287	2.15
XIII	3,402	4,707	1,305	2.18
XIV	3,400	4,713	1,313	2.19

Group XI was fed silage and cotton seed meal and corn and cob meal.

During the first part of the feeding period the concentrates were mixed in the proportion of two parts of cotton seed meal to one part of corn and cob meal. This proportion was gradually changed until about the middle of the feeding period, when it had been completely reversed and two parts of corn and cob meal were fed to one part of cotton seed meal. On this ration the cattle gained 1, 442 pounds, or 2.40 pounds per day. The gain compares favorably with that made by the best grades of beef cattle in feeding experiments conducted at stations situated in the corn belt, and is a sufficient answer to those who have believed, first, that corn was essential in order to obtain good gains with beef cattle; and, second, that silage and cotton seed meal could not be used to advantage in the production of beef in the South. The writer is of the opinion that this is the best ration that can be fed by Southern farmers, and while it entails the use of some corn, there is no reason why much larger quantities of that cereal should not be produced in the South than are grown today. It is simply a matter of selecting better varieties and giving the soil and crop better cultivation and attention generally. There is an abundance of land that might be utilized to advantage, and there is no reason why the present yield of corn should not be increased by at least one-half.

Then, observe that corn and cob meal was used, and as the cobs constitute one-fifth of the weight of a bushel of corn it is plain to all that the cobs add considerably to the feeding value of the corn crop. If it were possible to obtain a machine that would grind the corn, cob, husk and all, it would be a still greater advantage.

Group XII received silage and cotton seed meal alone, the amounts being increased in the same ratio as in the case of Group XI. Observe that these cattle gained only 1,287 pounds, or 2.15 pounds per day. Twelve pounds of cotton seed meal was more than steers of the size used could use to the best advantage, and it is probable that if the maxium amount fed had never been more than ten pounds, the results would have been equally satisfactory.

In Group XIII an attempt was made to feed eight pounds of clover hay along with the silage, corn and cob meal, and cotton seed meal, fed as in Group XI, with the expectation that it would affect a saving in the concentrates. This did not prove to be the case, however, nor were the gains as satisfactory as where the clover hay was left out.

Group XIV received silage and cotton seed meal and eight pounds of clover hay as well. They gained 1,313 pounds, or 2.19 pounds per day, so that there was certainly no advantage from feeding the clover hay with a ration of cotton seed meal and silage to beef cattle.

It has been frequently held that it is an advantage to feed a small amount of dry roughness to beef cattle on a heavy grain and silage ration, especially if the concentrates are laxative in nature. Clover hay did not answer the purpose, and, in the opinion of the writer, was not as valuable to the cattle as the run of a good straw stack would have been, and in order to determine this point, which is a matter of considerable economic importance to the feeder, straw will be substituted in the trials of the present winter for the clover hay. Notice, then, that all the cattle made satisfactory gains on silage and such concentrates as can be easily and cheaply produced in the South. The mixture of cotton seed meal and corn and cob meal, which proved most satisfactory, cost something under $20 per ton last year. The concentrates were bought on the Knoxville market and could, therefore, be purchased for much less by farmers living in the country.

As to the gains that were made, it is only necessary to say that the individuals in Group XI gained 360.5 pounds apiece in 150 days, and at the end of the feeding period were making gains that would justify their being fed for thirty to sixty days longer. These cattle weighed almost 1,200 pounds apiece when they went off the feed, and if fed for thirty to sixty days longer would have produced animals of just the right weight to suit the Chicago market. As it was, they were in excellent flesh, and were pronounced by a Chicago man to be in condition to bring a satisfactory price on that market. What further argument is necessary to convince the Southern farmer of the fact that he can utilize the silage and the concentrates which he now produces to advantage in the winter feeding of beef cattle, and that a fair quality of cattle produced in his home community can be winter fed to advantage.

Table II.—Consumption of Food.

GROUP.	Concentrates.	Roughness.	Concentrates.	Roughness.
XI	5,168 Lbs.	11.7 Tons	3.6 Lbs.	16.2 Lbs.
XII	4,984 "	11.7 "	3.9 "	18.1 "
XIII	5,168 "	10.5 "	4.0 "	16.1 "
XIV	4,889 "	10.3 "	3.7 "	15.7 "

In Table II is shown the concentrates and roughness consumed for the production of a pound of gain. Only a little more than two and one-half tons of meal were fed to any one of the groups, together with less than twelve tons of silage, during the 150-day period. The amount of concentrates consumed by Group XI was 3.6 pounds for a pound of gain, which was the lowest; the largest by Group XIII, namely, four pounds. The small amount of concentrates consumed for a pound of gain is truly surprising, in view of the fact that feeders in the corn belt often feed from sixteen to thirty pounds of crushed corn or mixed meal to obtain but little better gains than those made with these cattle.

The small amount of concentrates consumed is also remarkable in another sense, because in one instance only 16.2 pounds of roughness—that is, silage, was consumed with 3.6 pounds of meal for a pound of gain. Surely this shows the high feeding value of silage when properly made, and also that when cattle are properly fed a pound of gain can be made for the consumption of a comparatively small amount of food. Many farmers who have tried to feed beef cattle have undoubtedly fed two or three times as much concentrates as was necessary to make a pound of gain, and as a result instead of making a profit sustained a considerable loss. This should not condemn the cattle feeding business, but should teach the farmer that it is a new and rather complicated industry, and one that must receive the closest study and attention in order to be conducted on a successful financial basis; but when properly understood and conducted on strictly business principles by persons who understand the relative feeding value of the several foods available, it can be made a profitable business for the farmer, and one that offers him the best opportunity of reclaiming and building up his farm. It is an industry of especial interest to the South because of the worn-out condition of the land and the fact that there is no fertilizer equal in value to barnyard manure.

Many persons are of the opinion that the gain in weight from the inception to the conclusion of the feeding experiment must pay for the cost of the food or else cattle feeding is an unprofitable business. This is not true and can never be true, but is one of the fallacious notions that are liable to spring up from nowhere and confront a new industry.

As the writer has met many instances of this, it has been deemed advisable to present the following figures to show the unreasonableness of this contention, and at the same time to illustrate how nearly under the best system of feeding and management the gain in body weight may be made to offset the cost of food and attention.

Table III.—Profits Versus Food Cost.

Group.	Value of Gains.		Cost of.	
	Original Weight.	$5.00 per 100.	Food.	Food Cost Over Gain.
XI	$49.35	$72.10	$73.99	$ 1.89
XII	49.88	64.35	85.57	21.22
XIII	51.03	65.25	83.88	18.63
XIV	51.00	65.65	93.28	32.63

The gain in value on the original weight of these animals ranged between $49.35 and $51.03. The cost of the food ranged from $73.99 to $93.28. The increased gain made from feeding these cattle, which were sold at $5 per 100 pounds, varied from $72.10 to $64.35. In other words, in the case of Group XI the gain from feeding came within $1.89 of paying for the cost of the food, and in no instance did it fail to offset from two-thirds to three-quarters of the cost of the food, so that a very considerable part of the money made from the gain on the original weight was clear profit. In order to determine the profit from feeding an animal the gain on the original weight and the gain from feeding must be considered together, and if the feeding has been done in a rational manner and the cattle are of fair quality, there is no reason why a nice profit should not be obtained. One very important point which should not be overlooked is that one ration may prove so much more profitable than another, even when fed to cattle of practically the same quality. It is the selection of a ration that will give the greatest gain with the least consumption of concentrates and roughness that determines the profit or loss from feeding.

In Table IV is shown the results of feeding various forms of roughness with a light meal ration to the remaining sixteen cattle. The idea was to simply feed these cattle a little more than a maintenance ration and then put them on grass in the spring. It was expected to leave them on grass from four to six months, according to the season and the nature of the gains made, and see whether this was a more profitable method of handling cattle than the forced feeding which has always been discussed.

Table IV.—Gain in Weight of Stockers.

GROUP.	WEIGHT.		GAIN.	
	Initial.	Final.	Total.	Daily.
XV	3,118	4,005	887	1.48
XVI	3,153	3,735	582	.97
XVII	3,165	3,857	692	1.15
XVIII	3,223	3,847	634	1.04

In order that the experiment might be as comprehensive as possible, sorghum silage was fed to the first group, shredded corn stover to the second, sorghum fodder to the third, and Kafir corn to the fourth group. The animals were fed a meal mixture consisting of two parts of cotton seed meal and one part of corn and cob meal throughout the whole feeding period of 150 days. When first placed on feed they received at the rate of two pounds of this mixture per head per day. This was increased after several days to four pounds per head per day, which was the maximum amount fed at any time.

A note of explanation concerning the character of the foodstuffs fed and the condition in which they were given to the cattle will be of interest. The silage was made after the ordinary method and was sweet and palatable. It contained, as did that fed in the case of the other groups, a small amount of pea vines. It has been our policy to endeavor to grow peas and sorghum together by filling one hopper of a two-horse corn planter with peas and the other with sorghum. Of course it is necessary to use special plates in order to distribute the seeds uniformly and to avoid sowing too thickly, but by drilling two rows and reversing on the same, it is possible to put the peas and sorghum down together. By seeding after this method the peas are induced to climb on the sorghum stalks, and so the peas and sorghum can be readily cut with the corn harvester and run in the silo together. Only a small per cent of the silage fed consisted of peas. In spite of our best endeavors, not more than 15 per cent of our silage has ever consisted of peas, and in most instances it has ranged between 5 and 10 per cent, so that the excellent results obtained from feeding this silage cannot be attributed to the high feeding value of the peas. The corn stover was simply cut and shredded. It was nice and clean and sweet, but was eaten with less relish than any of the other foodstuffs. The sorghum fodder was not cut until headed out and the grain practically ripe. It was then cut with the corn harvester, bound in sheaves, and shocked in the field and allowed to cure for several weeks. Later it was drawn in the barn and the bundles set on end and packed in as closely as possible. It was run through a cutting box the same as the stover. The Kafir corn was in practically this same condition and was treated in a similar manner.

Observe that Group XV receiving the silage gained 887 pounds or 1.48 pounds per day. On the corn stover the gain was 582 pounds, or .97 pounds per day; on sorghum fodder 692 pounds, or 1.15 pounds per day; and on the Kafir corn 634 pounds, or 1.04 pounds per day. In other words, cattle of similar quality, when fed a limited Kafir corn 624 pounds, or 1.04 pounds per day. In other meal ration and a cheap roughness of silage or coarse fodder, failed to make more than one-half as much gain in weight per head per day as those fed on a forced ration. One of the particularly interesting things about the experiment was the splendid showing made by sorghum fodder which more nearly approached silage in feeding value than one would have anticipated. These results may be changed another year, but if the present ratio of gain should hold good it establishes the high feeding value of sorghum fodder when treated as described, and shows that where a silo is not available that the crop, if properly preserved, can be fed with a small amount of grain to stock cattle as a winter ration to decided advantage. This is a matter of very grave importance to the average Southern farmer who already produces more or less sorghum fodder or can produce it very readily, as it is adapted for successful culture under such a wide set of conditions in the South. The roughnesses were fed at the rate of from sixteen to twenty pounds per head per day, depending upon the appetite of the animal. The idea was to give them only what they would eat up clean.

Table V.—Profits Versus Food Cost.

GROUP.	VALUE OF GAIN.		COST OF FOOD.	
	Original Weight.	$4.00 per 100.	Food.	Food Cost Over Gain.
XV	$15.59	$35.48	$45.77	$10.29
XVI	15.77	23.28	36.87	13.59
XVII	15.83	26.68	43.12	15.44
XVIII	16.12	24.96	52.98	28.02

Table V shows that the gain in value on the original weight and the gains from stall feeding for 150 days at the sale price of $4.00 per 100 were not nearly so large as in the case of the cattle on a forced ration. The gain in value on the original weight varied from $15.59 to $16.12; the gain from feeding from $23.28 to $35.48. The cost of the food ranged from $36.87 to $52.98, and it cost from $10.29 to $28.02 more to feed these groups than the value of the gain from feeding amounted to. Nevertheless, there was some profit from feeding these cattle, and of course the gains made on the grass were sufficient to offset the comparatively small profit made from the stall feeding. This was naturally to be expected, and it is encouraging to observe that cattle can be fed on a cheap roughness and a light meal ration through the winter at some profit. Doubtless the profit can be increased considerably under a different set of conditions, but it has not been believed hitherto by the Southern farmer that he could afford to feed cattle through the winter to be put on grass the following spring. This is certainly a mistake, the increased gain obtained will more than pay for the food, the cattle will be of greater weight, will make as rapid gain on grass and will bring a better price.

Table VI.—Waste of Roughness.

GROUP.	ROUGHNESS.		
	Fed.	Consumed.	Wasted.
XV	22,890	22,890	
XVI	10,342	9,283.5	1,058.5
XVII	13,188	12,958	230
XVIII	12,590	12,496	94

Table VI shows the roughness fed and consumed by the stocker cattle. Observe that all the silage was consumed, practically all the sorghum fodder and Kafir corn, but that a considerable waste resulted when shredded stover was used. This waste, while not so large with four head of cattle, would amount to about 12.5 or thirteen tons where 100 head were fed.

Table VII.—Consumption of Roughness.

GROUP.	No. Animals.	Roughness.	Yield per Acre (tons).	Food Consumed.	Acreage to Produce Food Eaten.
XV	4	Silage	12.5	11.4	.91
XVI	4	Stover	2.6	5.2	2.
XVII	4	Sorghum	7.1	6.6	.93
XVIII	4	Kafir Corn	2.5	6.2	2.5

Table VII shows the amount of the various roughnesses consumed by the different groups of stocker cattle. It also gives the average yield in tons per acre obtained with these crops on the University farm, and the number of acres required to produce enough food to feed four head of cattle. This table is one of great interest to every farmer. Much larger yields of some of these crops, particularly silage have been obtained on the University farm, but it has been the endeavor in this paper to present what might be termed a fair average of results so they might not prove misleading. Observe that the four head of cattle ate 11.4 tons of silage, or the amount produced on .91 of an acre; 5.2 tons of corn stover, or the amount produced on two acres; 6.6 tons of sorghum fodder, the amount produced on .93 of an acre; and 6.2 tons of Kafir corn, the amount produced on 2.5 acres. Notice that an acre of silage produced enough roughness to feed four head of cattle for 150 days, while it took more than twice as much land to produce the amount of corn stover needed. This is a good argument in favor of the cheapness and value of silage, as the crop is preserved in the best possible condition for feeding, has only to be handled once, and will go further in proportion than any other crop that can be produced, unless it would be sorghum fodder. These figures show that a wonderful amount of roughness can be produced on an acre of land in the South, and that the same, when properly preserved, can be utilized to advantage in the winter feeding of beef cattle.

Table VIII.—Cost of Silage.

CROP.	Distance of Drills.	Seeded.	Harvested.	Yield (tons).	Cost per Ton.
Sorghum and peas	3½ ft.	May 16	Aug. 25	14.59	$1.32
Sorghum and peas	2 "	May 10	Aug. 27	19.95	1.15
Sorghum and peas	3½ "	May 9	Sept. 1	11.95	1.21
Sorghum and peas	2 "	May 7	Aug. 29	12.47	2.02
Soy beans	2 "	May 12	Sept. 29	9.55	2.20

That silage can be produced cheaply from sorghum and peas is shown by Table VIII. Experiments have been made to determine what is the best distance to plant the crop in order to obtain the largest yield at the least cost. When planted in two-foot rows a yield of 19.95 tons per acre were obtained at a cost of $1.15 per ton. The next best distance was 3½ feet, 11.95 tons at a cost of $1.21 per ton. The writer believes three feet to be a safe distance for the planting, and that sorghum should be put in rather thickly, for it can stand a good deal of dry weather and still come on and make a heavy yield, and if planted early in May it may be left to grow and mature, if necessary, until late in October, even as far north as Tennessee.

Notice that soy bean silage cost $2.20 per ton, and so far as we have been able to judge, was not as satisfactory as the sorghum and pea silage. Mammoth Yellow soy beans, when grown by themselves in rows twenty-four inches apart, can be mixed to advantage with sorghum planted in three to three and a half-foot drills by putting alternate loads in the silo. The Mammoth soy bean can be readily cut by the new model Deering corn harvester and bound in sheaves, thus greatly facilitating the handling of it. When put in the silo the juices are sufficient in volume to soften the coarser stems and practically the whole plant is consumed, whereas, soy bean hay is too coarse to be as readily disposed of by cattle as cow peas. In the manner of their growth soy beans have an important advantage over cow peas for the silo, as they do not run and tangle and are much easier to handle.

As to the value of sorghum for silage there can be no question, as we have made it successfully on the University farm for the past four years, and it can be counted on to outyield corn every year. If sorghum is allowed to sufficiently mature before ensiloed there will be no trouble about preserving it, provided the silo is properly constructed in the beginning and the silage well packed around the outside wall. Most people fail in making sorghum into silage because they cut it too green. Our sorghum is not cut until the heads are formed and the grain practically ripe. It is then bound into sheaves with the corn harvester, which are allowed to lie on the ground for a portion of the day and the ensuing night. This allows some of the water and acrid juices to escape, and when put in the silo in this condition and mixed with peas or soy beans, as suggested below, no finer silage can be made anywhere in the world.

As to the cost, the figures presented in the table show that when grown on comparatively small areas of land and an accurate record kept that silage can be made in the South for about $1 per ton. On the average farm it can be made for less than at the Station, because larger areas of land would be utilized, and then the cost has been figured at city prices for teams and extra laborers, which, as every one knows, are much higher than in the country. These facts demonstrate beyond all question that silage can be made cheaply, that large yields can be obtained, and that sorghum and peas or soy beans can be utilized for the winter feeding of beef cattle. There can thus be no reasonable excuse for the farmer not feeding beef cattle because he is of the opinion that cheap roughness cannot be grown satisfactorily or that silage cannot be utilized profitably in the winter feeding of beef cattle.

Table IX.—Financial Statements—Feeders.

GROUP.	Buying Price.	Cost of Food.	Total Cost.	Selling Price.	Profit.
XI	$115.15	$73.99	$189.14	$236.60	$47.46
XII	116.38	85.57	201.95	230.60	28.65
XIII	119.07	83.88	202.95	225.35	32.40
XIV	119.00	93.28	212.28	235.65	23.37

Table IX shows the profits obtained from forced feeding or beef cattle. It gives the buying price, cost of the food, the total cost and the selling price. Observe that the profits per group ranged from $47.46 with Group XI to $23.37 with Group XIV. This is a wonderful difference, not due so much to the quality of the cattle, but rather to the kind and amount of food utilized. Observe that these cattle all made a fair profit no matter what the ration fed, and if all had been fed the most satisfactory ration, practically $200 would have been cleared upon feeding sixteen head of cattle for 150 days. Then, it must be remembered that the profit includes the cost of all labor in connection with the feeding and that the manure was not considered, the manure being more than sufficient to offset the cost of the care, so that the profits obtained from the transaction were considerably larger than those shown. In fact, very much larger, for there is no fertilizer so much needed on Southern farms as farmyard manure. Then it is well to remember that these profits would be larger on the average farm because one man, with a proper barn and equipment, could care for 150 to 200 head of 800-pound steers.

The best place for feeding these cattle would be a well-roofed shed open on the sides. It may be constructed by sinking either cedar or oak posts in the ground and putting a shingle, tin or board roof over the structure. The feeding troughs may be swung by chains between the supporting parts. The silo should be constructed at one end of the barn. The barn should be built on level ground and a retaining wall one foot high built around the outside, either of stone, brick or wood. Then by threshing the grain at one end of the barn and having the silo and granary at the other, the feeding can be quickly and easily done and fresh bedding thrown in each day to be tramped down by the cattle and made into farmyard manure. There are thousands of farms in the South where the business could be conducted along the lines suggested to the decided advantage of the owner of the land, and it is only a matter of time until facts of the kind set forth in this paper become disseminated and appreciated until the winter feeding of beef cattle will be a successful and thriving industry in the South.

Table X.—Financial Statement—Stockers.

Group.	Gain.			Profit.		
	Feed.	Pasture.	Total.	Feed.	Pasture.	Total.
XV	887 Lbs.	610 Lbs.	1,497 Lbs.	$ 5.30	$31.48	$36.78
XVI	582 "	920 "	1,502 "	2.17	44.08	46.25
XVII	692 "	888 "	1,580 "	.38	43.75	43.63
XVIII	624 "	886 "	1,510 "	11.91	43.11	31.20

Table X shows the profit made from feeding sixteen cattle through the winter on a cheap roughness and a light grain ration and then finishing on pasture. Observe that the cattle on silage only gained 610 pounds on pasture. It is well to remmember, however, that one of the steers in this group was not in good health for sometime before being put on pasture, and made no gain whatever during the grazing period. The largest gain on pasture was made by Group XVI, fed corn stover; the next by Group XVII, fed sorghum hay; and the next by Group XVIII, fed Kafir corn. Notice that the total gains made were larger than the best made by the cattle on forced feed, but it is well to remember that these cattle were on grass four months, and therefore were kept at considerable risk to the owner for about twice as long as the forced-fed cattle. These cattle failed to make much profit from the stall feeding, and Group XVIII lost $11.91. On pasture they did much better, a profit of $31.48 being obtained on the silage-fed cattle and $44.08 on the stover-fed cattle. Pasture was charged to these cattle at the rate of $1 per head per month. This would be at the rate of $12 per year, which would certainly be a handsome rental for the land. They were on good Tennessee blue grass pasture, not the best and not the poorest. The gains made on the grass were satisfactory in every instance, except with Group XV, which has partly been acounted for. The total profit made by these cattle ranged from $31.20 to $46.25. In the long-run they made but little more profit than the stall-fed cattle; so little that there was not much to choose between the two methods of feeding, except that the cattle on grass were kept much longer, required more care and attention, and greater risk was naturally run with them than with cattle put on feed in the fall, pushed through and disposed of.

While these results present only the figures for one year and may be greatly changed by further investigations, they show that cattle can be stall-fed on silage, corn and cob meal and cotton seed meal for 150 to 180 days to the material advantage and profit of the Southern farmer; that they can be fed at practically the same profit and with nearly the same gains as cattle run through the winter on a light roughness and meal ration and finished on grass, and that there is not so much to choose between these two methods as has been commonly thought. So that in case it were true that we had no grass, there is still no reason why the winter feeding of beef cattle should not be made a profitable and thriving industry in the South. The facts presented in this paper are certainly of importance to our people and they are well worthy of their careful study and consideration.

These investigations were planned and carried out jointly by Prof. John R. Fain, Assistant Agriculturist of the Tennessee Station, and the writer, and to the former's faithful service the excellent results obtained are largely due.

INDUSTRIES AND IMMIGRATION.

BY ROBERT GATES.

I AM free to confess that if Tennessee capital and Tennessee young people could be kept at home for the work of progress I would not care to see extraordinary efforts made to secure outside capital or attract immigration. Millions of money is made in Tennessee that goes out with the brains and energies that amassed it to enrich other States. Thousands of our best and brightest young people go to develop and build in other lands. Under present conditions, possibly under no condition, can this movement be stopped, in part at least, and it may be that it would not be wise to stop it altogether. But that a material check upon this heavy drain of brain force and enterprise, capital and energy, would be of immense value none may doubt.

There is no better blood than that which courses the veins of Tennesseans, and for that matter the "Old South" entire. It is for the most part of English, Irish and Scotch sources, Anglo-Saxon-Celtic, the blood of the Revolution and of the early wars of the republic. It is the blood that baptized this marvelous continent with its matchless combination of climate and resources to republican government, renewing the hopes of humanity in government of the people and for the people, and setting up a beacon light of constitutional liberty to inspire and guide the world. It is the blood that will yet prove "the saving grace" of Anglo-Saxon civilization on this continent, and I for one would not see it impaired by weaker strains.

But to maintain this matchless type of the world's master race, on a field marvelously adapted to the development of the best characteristics of Anglo-Saxon-Celtic manhood, two things are necessary; *i. e.*, industrial development, which employs brain and capital, and gives employment to and encourages labor, skilled and unskilled; and immigration from desirable sources in sufficient volume to strengthen the native strain, to inspire confidence in the desirability and possibilities of our section on the part of those "to the manner born," and to insure the right and inevitable solution of our race problem with the least evil to the whites and blacks. To no State in the South does this duty appeal with more force than to Tennessee.

INDUSTRIAL DEVELOPMENT.

Industrial Development.—This is being worked out in these days, in the main, on natural lines. Formerly political and social conditions, operating with necessity "the mother of invention," diverted industrial energies to inhospitable sections. Thus did New England for nearly a century lead the whole country, and lead it "far and away" in the matter of industrial development. Legislation supported and fostered this strained growth. Without raw material, hampered by lack of cheap fuel and embarassed by a harsh climate, the mines and fields of distant and more favored sections were levied on for their products, which being transformed into articles of prime use, were returned to their original sources enhanced many fold in value. The most sterile and inhospitable part of the country became the richest and ruled in business and politics. But a change is being brought about by a variety of causes, the chief being increased population and wealth, which demands more and better products and cheaper production—necessity this time promoting on natural lines. Conditions now demand that the machinery that fashions, and raw material that supplies shall get together. The furnace to the iron ore, the coal and limestone; the saw and plane to the forest; the stone dresser to the quarry; and the cotton mill to the cotton field—this is the demand of modern conditions. And so modern development is moving on the lines of least resistance.

Manufacturing centers exist, or are in embryo, whereever the raw material abounds. Wealth, long a "pent-up Utica" in New England, has broken away from those narrow confines and now spreads its wings wherever products and transportation invite capital and enterprise.

The South is making remarkable progress on this line. Here the iron, coal, timber, marble, copper, phosphate; the cotton, tabacco, fruit and vegetables, and the cereals unite with ever-increasing transportation facilities to encourage enterprise and attract capital. The progress being made in manufacturing and mining is almost marvelous. Alabama is now the second iron and steel producing State in the Union, and soon to be the first. Tennessee is a good third, with the Virginias, Kentucky and Missouri close up. All the Southern States are, more or less, dotted over with wood-working machinery. The marble industry of Tennessee heads the column on that line; and in phosphate output and in fertilizer factories she is ahead of all. But the most marvelous development is in cotton manufacturing.

In 1889-1900 the Northern cotton mills consumed 1,799,258 bales of cotton, and the Southern mills 549,894 bales. In 1902-3 the Northern mills consumed 1,967,635 bales and the Southern mills 2,000,729 bales. Thus in the consumption of cotton for manufacturing the South now leads the North.

Again, thirteen years ago the per cent of cotton consumed was, in the North, 76.7 per cent of the whole consumed in the United States, and the South 23.3 per cent. Now the per cent is, North 49.58, and South 50.42—the South thus more than doubling its percentage in thirteen years, while the North declines twenty-five per cent. Mr. G. A. Park, General Immigration and Industrial Agent of the Louisville & Nashville Railroad, gives out the following with reference to investments, industrial growth and immigration along the lines of the L. & N. R. R. in Kentucky, Tennessee, Alabama and Florida:

"During the first ten months of the year investments along the road in these four States aggregated $9,366,300 in eighty-seven industries. Eight hundred and five families of 2,563 persons from other parts of the country settled in these States. These purchased 95,702 acres of farm lands and 255,048 acres of mineral and timber land. The industries established during the ten months include forty-six wood-working plants, four ice plants, three textile plants, two sugar and syrup plants, three coal mines, four iron and steel plants and twenty-two miscellaneous industries. Of the forty-six wood-working plants, twenty-one were established in Alabama."

He gives the following figures as to Tennessee: thirteen wood-working plants, capital $90,000; one ice and cold storage plant, capital $100,000; one woolen mill, capital $50,000; six miscellaneous industries, capital $67,000; total, $307,000.

This is for ten months of the current year and does not embrace Memphis and Nashville where other roads are interested, but is confined to L. & N. points, or where there are simply railroad crossings. For the same period 471 settlers were located in Tennessee, who purchased 14,254 acres of land. It is gratifying to note from this report that Tennessee stands second in results, Alabama alone being in the lead, both in industries and immigrants.

All the Southern roads are working liberally on this line. They are spending many thousands of dollars annually to advertise and develop the South.

Other roads in the South have, no doubt, done as well as the L. & N., and some probably better during this same period, as the I. C. and Southern especially, have more mileage in the South, and the N., C. & St. L. more in Tennessee. The latter road is especially active in the work in this State. But the facts and figures given are ample to demonstrate that the South is the field of future development in this country. This view becomes more convincing when climate and soil are considered, which combine to produce the greatest diversity of soil production in the world, minimizes the cost of living and makes possible a measure of comfortable living that is impossible in Northern climates and sections of less diversity of production.

When the great inter-oceanic canal, which now seems certain, is constructed, industrial development in the South will be incalculably accelerated. Charleston, Savannah, Pensacola, Mobile, New Orleans, and Galveston will become the main entry ports for the vast commerce of Central and South America, the islands of the Pacific, the Philippines and the Orient. The whole South will be immensely quickened on every line of progress. Production and population will multiply in the midst of inexhaustible resources of mines and fields and forests, and a climate that renders the fullest development possible. Who will presume to challenge the prediction that, the "Old South," with its Anglo-Saxon-Celtic blood, its glorious traditions and matchless history, its salubrious climate and diversified productions, its wealth of minerals and forestry, will yet be the seat of empire in America—the composite power, mental and material, that will preserve this continent to liberty and constitutional government.

Tennessee must keep her place in this great movement. We must encourage enterprise and capital. We must more and more fashion our raw material into finished goods. We must dig and build, spin and weave, cultivate and grind, grow and can. We must let the world know that

Tennessee has not only the resources to invite but the wisdom to protect capital and enterprise.

Thus we may build home markets and better reach distant ones. Thus we may give employment to thousands of our men and women who now go to other sections for work. Thus we may encourage the enterprise of our own people. Thus we may keep a healthy per cent of our young people at home to build and prosper around the old homesteads.

Invest your money in home enterprises. The more you invest the more outside money will come for investment. Put less in the banks and more in factories. Keep your money out of the bucketshops and put more of it into the workshops.

In this connection, let me say that there is, barring possible bad management, a safe line of manufacturing investment. When the surplus capital of a community that enjoys reasonable transportation facilities is invested in manufacturing the raw material produced into finished goods, no mistake is made. Transform the raw material into articles of prime use should be the shiboleth of progress in our State.

As to transportation facilities, any community that has a trunk line road, or connection with one over friendly roads, is safe to manufacture within its limitations of raw material—provided there is a demand for the particular goods that may be manufactured. There is ample proof of this statement in the census of 1900. It is being constantly accentrated. The railroads, for sound business reasons may be relied on to take care, as far as rates are within the control of the road interested, of legitimate enterprises on their lines. Then I would say, manufacture the raw material at hand and thus develop the resources of the State. Build up home markets, make places for those who work, encourage enterprise and invite capital by investing your own surplus. Remember that progress or retrogression are as absolutely laws of civilization as growth and decay of the physical world. Conditions existing today will not stand—change for better or worse is inevitable. There is no *now*—it is ever and always *was* and *may*. So we must advance with the great army, ever moving forward, or fall back with the stragglers and perish. Old times will come no more forever—it is the new day, we must meet with its duties and changes, its triumphs or disasters.

Tennessee is great in history, great in the character of her people, great in possibilities—let her sons and daughters see that she keeps her place in progress. Let all unite on those policies that will give employment to home labor and home capital, that will encourage home enterprise and invite outside enterprise, that will keep a healthy per cent of our best at home and attract a goodly per cent of the best from abroad. *This is the road of industrial development, of prosperity and power.*

As to Immigration.—I favor a reasonable amount from desirable sources for three reasons, to wit: First, to inspire our own people with confidence in Tennessee and keep more of them here; second, that the development of our race may continue on strong lines; third, that the race problem, which is being complicated by politics and fanaticism, may be solved with a maximum of good and a minimum of evil—for solved it will be, and rightly.

1. Too many of our people are emigrating West and building fortunes in other States that might be built here. Immigration will check this. It has already done so, for the facts show that the countries receiving the largest accretion of settlers from other States, show the smallest emigration. The reason is, that the new settlers, often bringing improved methods and trained in thrift, demonstrate to the natives results hitherto deemed impracticable. Crops are produced and economics exercised that encourage and educate. Besides, we naturally appreciate

what we have the more it is esteemed by others. So I hold it true, and in a degree already demonstrated, that immigration will, in a measure, stop emigration.

2. An infusion of new blood from *desirable* sources will strengthen the native strain. This is amply proved in history. The Anglo-Saxon is the product of Tuton, Scandinavian and Celt, and is the highest type of the white race yet developed. America may produce a higher type by drawing from the original sources of the Anglo-Saxon strains, to be assimilated as in Great Britain, but on a wider and more favorable field. The South is the most inviting field for this improved production. Here the Anglo-Saxon-Celtic strain is the purest. Upon it the best types of the original European stock may be grafted with the best advantage. And the immigration South is from the North, native American, or Americanized European, the most desirable source possible from which to draw racial strength for higher development. I repeat, immigration South is of the most desirable character. It comes from sections where progress has had its most perfect work. New ideas, needed economies, and trained enterprise comes with it to infuse and quicken a conservatism that needs the inspiration of enterprise, thrift and newness of life.

3. Immigration will tend to the solution of the race problem in the South with the least friction. It will educate both ways, educating the immigrant by contact and the North by retroacting influence, while strengthening the South for those policies necessary to the peace and well-being of both races. The Northern immigrants settling South will learn in the infallible school of experience. They will inevitably imbibe the Southern view—the fact is they become, as we know, rather extreme advocates of "white man's rule." Thus they strengthen, and will more and more, the white race in the management of the problem, and its solution will follow on lines of least peril to

whites and blacks. In numbers there is strength, in co-operation there is success. But this is not all—these Northern immigrants will do a great work by educating back into their old homes, and thus the North will be gradually enlightened in a way, slow, it is true, but most effective and fruitful. I have no fear of the ultimate solution of the race problem in this country. It will be solved on the old and established lines of adjustability and survival. It's a very old problem—its cities and its cemeteries are alike thick in the long past. He that runs may read, be he not blinded by fanaticism, or perverted by sentimental sympathies, or corrupted by party politics.

There is but one standard by which to measure a race—a standard universally acknowledged as to individuals and nations—*achievement,* what a race evolves within itself. Try the races by this universal, immutable and infallible standard, and what is the result.

In the beginning of humanity, whether we accept the Biblical account with the curse of Noah upon his unchaste son, or the scientific accounts of learned investigators, there were three primal races of men, the white, the yellow and the black. What have these original races achieved within themselves. The yellow race inhabiting the larger part of Asia worked out a civilization within itself that culminated in a Confucious and his times, a high civilization of much attractiveness. But it reached its limitations a thousand years ago, and has only advanced since where it has come in contact with and imitated the civilization of the white race.

The white race at an eary date inhabited Europe, and there built and from there exploited itself. It has evolved within itself and of itself, a civilization the most splendid the world has known. Its laws, its literature, its science dominates the earth. Where it has come in contact with other races it has mastered them and rules them or annihilated them.

The yellow race of America it has practically blotted from the earth. The mixed races of India it has subdued and rules. To the yellow race of China it dictates. The black race of Africa it has practically, in one form or another, enslaved.

But for itself and the world it has evolved and developed a civilization the most splendid of all times. A civilization still progressing and conquering, rendering any prediction as to its limitations too bold to be indulged. Its character is a synonym of progress, sleepless, irresistible, all-conquering.

The black race time out of mind has had its home in Africa. What has it evolved? What has it achieved? Where its civilization, its jurisprudence, its literature, its science, its government, its cities, its mental or material triumphs? There are none. "As creation's dawn found it," it is now, except where through slavery, or transportation, or contact, it has been thinly veneered by one of the superior races—the white or yellow. "It has never redeemed a native jungle from the monkeys," or a prairie from the wild beasts. Of its self it has done nothing.

Hence, in the light of history, there is no such thing as racial equality, but superior and inferior, as on every other product of earth or heaven, is stamped indelibly and forever. And the law that governs their relations is a law of nature, as immutable and remorseless as any other natural law, the violation of which is degredation and death.

A superior race has never, anywhere at any time, lifted an inferior to its own plane, but on the contrary, it has in every instance been dragged down to a lower plane of fatal limitations by miscegenation.

For illustration, behold the mongrel races of many of the Eastern lands and islands, of Egypt and Abasinia, of the Philippines, of Northern Africa, of the West Indies. Behold the turbulent peoples that abuse the gifts of nature in Central and South America. Inquire what of the descendants of those Greeko-Semites who fled from Tyre with Queen Dido and established the kingdom of Carthage; of those blue-eyed, yellow-haired Tutonic tribes who, in the Middle Ages, set up their kingdoms on the Southern shores of the Mediterranean Sea.

History is full of the tragedies of miscegenation.

Equality does not exist—cannot exist—history denies it, nature abhors it, *for mongrelism is degradation and death.* Nor does it matter whether it be by mixing the yellow and black, or the white and yellow, or the black and white, the curse of nature is alike over all.

The hope of each of the primal races—white, yellow and black—is in the preservation of each separate and distinct. Adjustability and survival, the one a practical present force, and the other a slow but remorseless process, are the final arbiters, and will in the distant future determine whether all, or which, shall finally stand upon the earth.

But, as I said, I have no fears of the final result in the solution of this problem. I would make its inevitable solution smooth, humane and peaceful, as we give medicine to help nature work its own cure. More whites in the South will promote this end. But to quicken the process we should supplement our laws against inter-marriage with as strenuous ones against cohabitation and enforce them by all legal machinery and *by public opinion. Races have the right of self-preservation, and should protect themselves against the brutalized and the perverted.* Eliminate the mulatto and the race problem is more than half solved—not that its solution will be estopped by the partial and unhallowed miscegeneration going on, to the shame of both races, but that otherwise it will be rendered more bitter and cruel. The solution, in any event, will in the end be the same, for the Anglo-Saxon-Celt will not, has not, tolerated other results anywhere on the face of the earth. The inferior must submit to the political and social ascendency of the superior. But the mulatto, the quandroon and octoroon are to be pitied. They are pathetic figures in the political-social systems, and deserve sympathy with a measure of toleration. They carry in their faces a mother's shame. They are spurned by the whites and suspicioned by the blacks. They have some of the intellect, pride and aggressiveness of their white blood, and yet are held down by the black with its weaknesses and limitations. They are to be pitied, and in many instances feared. For when educated, they become per force of environment, leaders and agitators for racial equality, political and social recognition. Then eliminate or at least minimize the mulatto and the rest may be safely left to adjustability and survival. My plea is for both races, for peaceful relations, and the best possible results.

In the meantime the South will have the best laborers in the world. Good treatment will make this sure under the policies suggested. The blacks should have perfect equality before the law. Their treatment should be kind as well as just, and if so, the old sympathy between Southern whites and blacks, not yet entirely gone, will return, and the races will work out their destiny in peace under the laws that govern racial relations and human development. And the South will, by its wisdom and its faithfulness to its race, confer upon the whole country inestimable blessings, which posterity at least will recognize and honor.

Another thought: It is primarily essential to the future of the South that the superior race shall continue to be, in the main, the land owners, the farmers of the land. An intelligent, proud, spirited, ambitious agricultural class is essential to free government and the best progress. *The degradation of the agricultural class would be fatal to the republic.* So long as the farming class is intelligent, proud as having a history, progressive and ambitious, freedom is safe and development on healthy lines assured. It is of the first importance, therefore, that the land, the farms of the South shall in the future remain, in the main, in the hands of the white race. *This result immigration will help to promote.* And for this reason, among the others given, I favor a measure of immigration from the best white sources.

Then, I say to you farmers, that you can do much on the lines laid down for yourselves, your country, your race and civilization. You can greatly advance the State by demanding racial purity and encouraging development and healthy immigration along the lines indicated. You may keep the larger per cent of your best at home, and attract the best from abroad. You can do more than all others to make Tennessee greater—nature's favored home of industries and diversified production—a veritable land of promise—where the mighty race that is conquering the world in moral and material power is purest and its possibilities greatest.

In behalf of all interests working to these ends I bespeak your encouragement and co-operation.

SOME SUGGESTIONS UPON HEALTH MATTERS UPON THE FARM.

By J. A. Albright, M. D.,
Secretary State Board of Health.

AT the request of Mr. W. W. Ogilvie, Commissioner of Agriculture, and also member of the State Board of Health, I have prepared a paper containing a few suggestions to the farmers that may prove of practical benefit in restricting the spread of communicable diseases throughout the State. Papers on hygiene and sanitation are always written with a view of improving the healthfulness of the cities and towns, and very little is said or done that tends to render more sanitary and healthy the farm premises. This is in a measure due to the fact that every one knows how lavishly nature has bestowed her gifts of pure air and pure water upon those living in the country, and in this condition it should remain if a few sanitary precautions were closely observed and faithfully executed. Therefore, I shall claim your attention for a short while and present to you a few practical suggestions and rules in the most practical manner possible why farmers should keep pure and unpolluted their drinking water and streams, and thereby prevent the spread of disease in their own houshold and the community in which they live—in other words, how diseases result from impure water, and how by complying with the law and co-operating with the health authorities they can be averted and stamped out.

About two months ago I visited Springfield, Robertson County, Tenn., and found the sheriff of the county and others suffering from smallpox. We traced the origin of the disease to a point across the border in Kentucky. We found, however, a circular letter that had been scattered throughout Robertson County written by a Kentucky doctor setting forth the fact that the disease was not smallpox, but was simply an epidemic skin eruption, and was due entirely to the dry weather and the low stage of the water. He failed to state how much or how little water was used, or whether it was for external of internal purposes. Now, if water used internally or externally in any quantity or quality could so affect a Kentuckian that an eruptive skin disease of an epidemic character should develop, should not the Tennesseans across the border in the same section of the fertile blue grass region pay some attention to the character and condition, source and origin of their water supply? Whenever springs are utilized for drinking water all farm houses should be located so that all drainage from them should be carefully conducted or conveyed to a safe distance below the spring. Frequently wells become infected by sipage from surface infection, and especially is this true when there is a sandy subsoil, which will permit of easy percolation; therefore, stables, privies, hog pens, etc., should be at a safe distance and to the side of either well or spring where drainage is easily affected. How to keep water from becoming infected is a very important subject, as well as a very difficult one to people living in the country on acount of the careless disposition of all eliminated matter and effete material. The source of infection of a great number of dangerous and fatal diseases are traceable primarily to this eliminated material, and widespread epidemics result therefrom. That dread disease, typhoid fever, can most always be traced to an infected water supply, both in the country and city. The germ that conveys the infection in this disease is always to be found in the excreta and urine, therefore, all discharges before being disposed of should come in contact with chloride of lime, either in powder or solution. Antiseptics or heat at 210 degrees are the only agents that will destroy a typhoid germ. Cold water or air has no power in their destruction. Neither does their mixing and mingling over rocky shoals for short distances, in either stream or river, diminish either their number or virility, but on the other hand, for awhile seems to furnish an opportunity for their reproduction. In 1884 a great epidemic of typhoid fever developed in Montreal. So sudden and universal over the city was the outbreak as to create the greatest excitement and alarm. The health authorities began to search for the cause, and found that in the month of November, in the year preceding, a family living along the river about 200 yards above the city waterworks had had typhoid fever. It also developed that the excreta and urine were handled in a careless manner, being thrown upon the snow, where it remained frozen as in a block of ice until the warm sunshine of spring melted the snow and set at liberty the little prisoners, who found their way into the river where they were immediately taken into the city's water supply. The result was an epidemic universal over the city with the loss of many lives.

In 1875, in Alabama, a crowd of young people attended a picnic in the country and used water for drinking purposes from a stream that flowed through the grove where the picnic was held. Within three weeks one hundred and fifty cases of typhoid fever developed in the community, and was confined exclusively to those who attended the picnic. Upon investigation it was found that a family consisting of husband, wife and three children had all been suffering with typhoid fever living within a few yards of the stream about one mile above the picnic grove. They had thrown the excreta and urine into the stream, thinking it the best and safest way to dispose of it. I mention these two instances to show you what dire results follow the careless disposition of excreta, and how highly important it is to prevent any impure or polluted matter from being thrown into a stream. In this connection, remember it is well-nigh impossible to disinfect either well or cistern that once becomes infected with typhoid fever. As hot water, at boiling, and antiseptics are the only effective agents, you can readily see that one is impractical and the other would permeate the walls and render unfit the water ever afterwards for drinking purposes.

What I have spoken concerning the contagion of typhoid fever and the method for its management and suppression is applicable to many other diseases that spread with as great rapidity in the country as in the city. The reason for this is that necessity has made more imperative the prompt report, by both physicians and the heads of households, in the city than in the country. And right here permit me to call your attention to the fact that, while philanthropy and the duty you owe yourselves should enlist your concern and attention, the law of your State makes it mandatory as well. I call your attention to clause of Acts, passed April 10, 1893:

SECTION 1. *Be it enacted by the General Assembly of the State of Tennessee,* That whenever any case of smallpox, yellow fever, cholera, or other communicable disease exist (except it shall not embrace any venereal disease, such as gonorrhoea, syphilis) or is suspected to exist in any household, it shall be the duty of the head of such household to immediately notify the municipal or county health authorities of the twon or county wherein such disease or diseases exist, or is supposed to exist.

You will observe, as the head of the household, the law makes it your duty to report immediately to the County Health Officer all diseases that are contagious or communicable, or that you may even suppose to be of this character. Never conceal the presence of a disease from the health authorities, even if it should be the old-fashioned itch. This should be impressed upon our public school commissioners in the country where so many children are so often permitted to mix and mingle with each other, you will observe Section 3 of the same act, commencing with line 14: "if in the rural districts, and said public school authorities shall not allow any pupil to attend any public school from said house while any inmate of same is sick of smallpox or other communicable disease, or during the period of two weeks after the death, recovery or removal of such sick person."

The law is very plain, and those to whom its execution is entrusted should see that in the future it is more thoroughly enforced. Our able and efficient State Superintendent of Public Instruction has assured me of his hearty co-operation in the enforcement of this clause.

Notify the health officer at once, and comply in every particular with his instructions.

Until this is done you must isolate the sick person, allow no one, except an immune or those in attendance, admitted to his room or presence. In other words, put him in quarantine and let him there remain until the disease is diagnosed, and then follow out the instructions of the health authorities. Don't kick against anything.

There are some contagious diseases in which the danger is greatest just as the patient begins to get well, notably smallpox and scarlet fever, and herein lies the greatest danger to the spread of these diseases, and which can only be obviated by obeying, in toto, the instructions of the physician in charge and the health officials.

The germs of these two diseases are found principally in the exfoliated or dead skin, also in the mucus membranes of the mouth, nose, throat, ears and bowels and kidneys. In short, in the skin, mucus membrane and in all eliminative organs. Clothing, carpets and bedding are mediums for the transmission of these diseases from place to place, and furnish choice dwelling places for these germs to develop future mischief.

Now, Professor Rosamon has talked to you about the Wooley-Aphus, and how to get rid of him. The treatment to prevent disease to the grape and the plum and peach has not fallen upon listless ears. The same pungent sulphur fumes used to prevent the grape's destruction will destroy the contagium of smallpox and scarlet fever, and render sanitary a room and its belongings where either have existed. Heretofore much sickness around the farm, such as chills, etc., has been attributed to the ever-present pond, and sometimes a step further has been taken and the good housewife's water barrel has come in for its share of censure. Both can be made perfectly safe by the use of coal oil poured upon the surface every two weeks during the mosquito season. The medical profession are undivided as to the cause of malaria, and now know that it is the product of a certain class of mosquito, and the destruction of him and his eggs will prevent the development of the disease as sure as the death of the Bophihis Bovi will stamp out Texas fever among cattle. I would like to talk awhile upon pure food and pure milk, but time and space forbid, and I will only say that the purity of these commodities and products do not appeal to you as your city brethren from a public health standpoint, but their adulteration does affect you in a commercial way, and it should commend itself to your thoughtful attention and enlist your hearty co-operation to the end that some intelligent legislation may be enacted to prevent the adulteration of both food and drink.

KEEPING BOYS ON FARMS.

By W. T. Roberts, Riceville, Tenn.

IF you wish to be told how to do a thing, get a fellow who has never done it and he can tell you exactly how it should be done. I have never had any experience in training boys, but I have been a boy—a boy on a farm. I remember my first knife, my stick horse, my home-made wagon; I remember when we boys burned sedge fields and slaughtered the rabbits as they ran from the approaching fire. I made my first money cutting cord wood, about $8; I went to town at once and spent every cent of it, buying a pocketbook with the last 20 cents, and carried it empty a good many days—but I had a pocketbook. My first felt hat was bought in this deal. I was given a colt about this time, which was worth a whole drove of any horses I have ever seen since, but I was not at the highest point until I had a saddle, then I had nothing further to desire. Of course I had a pair of high-heeled boots, a paper collar and a song book. To you, who were country boys in the early 70's, this is evidence that I was a boy on the farm. But is it desirable to keep the boy on the farm, desirable from the standpoint of society, the farm, and the boy? When I began to study this subject it was more with reference to society and the farm than to the boy, but as I studied the former began to dwindle, and now society and the farm are almost obscured by the boy, except as they have reference to the boy. Society is made up of individuals and is good or bad as the individuals are good or bad, and the farm is but the abiding place of its owner and reflects him, and is desirable as an abiding place in proportion to the owner's intelligent care. No argument is necessary here. Again, society is subject to environment; take a neighborhood and if it is a prosperous farming community, then you will find the cleanest, best society to be found anywhere; and, additions to that community will come to be what the rest are if they stay there, because we are, as before stated, unavoidably influenced by environment. Imagine every farm in Knox County, owned and tilled by intelligent and thrifty farmers—this presupposes moral, upright, honorable men—and you will at once acknowledge that if such conditions existed in Knox County, the county would be an ideal place, and not one of you but would gladly make it your home. This will not be until we can keep our boys on the farm.

The farm—does it need that the boys be kept on it? Have you had your eyes open? Have you marked the course of events for, say twenty years? If not, go back with me. I believe it safe to say that four-fifths of the farms in East Tennessee have been steadily going down for a longer period than twenty years, nay, for 100 years. Where once were fertile slopes that would respond to but fair cultivation with twenty-five to fifty bushels of corn per acre, are now yawning gullies that cannot be crossed; what were once fertile valleys that gladly gave back some forty, some sixty and some an hundred fold for the toil of the husbandman, now will barely give a subsistance. Meadows, where once barns full of fragrant hay might be gathered, are now over-grown with willows and swamp grass. This country of ours that twenty years ago shipped out wheat, corn and hogs by the hundreds of carloads, are now shippig them in at the same rate. I am not an alarmist, and the statement that I now make is new to me, as it has come to me since I have been studying for this paper, and it is this: That, under present conditions, it means absolute want in the near future; and, in the end, famine.

Consumption, by reason of the fact of city congestion, is on the increase at an abnormal rate, and production, on account of country depopulation, is diminishing at the same ratio, and it is further diminished by the depletion of the soil and the slipshod methods of cultivation. What can the end be but famine if these conditions continue? But here we see a ray of light; necessity will cause a turning of the tide, and I would like for you to mark this statement: in the near future one of the most valuable assets in all this country will be a good farm, and here, if you get your boys to see it, is one of the best "hows" to keep your boys on the farm. For a moment let us look at the other fifth of the farms that are improving. They lie side by side of the four-fifths of worn-out ones; the same markets have been and are accessible to all; the same opportunities, as a rule, have been open to all alike; where, then, shall we look for the cause of the difference? It is the man behind the plow! So it is the man, the grown-up boy that makes the farm. An all wise God made man to have dominion, and as long as he exercised that dominion every force of nature is his servant to help him on to success, and what a wonderful privilege is his to control. Now, will you conclude with me that it is best for the farm to keep the boy on it? The boy—this best of earth's products, except the girl. We would do for his best good at all cost. We would give up horses, lands, herds—all, for the boy. Talk of the best way to raise mules, it is nothing compared to keeping the boy from running down! How to keep the farm from running down, what is that compared to how to keep the boy from running down. How to train a horse—rather a thousand times how to train a boy. If we can find a way to get the boys to do their best they will attend to all these other things, and if it is not best for our boys to keep them on the farm, God forbid that we should do so, but if it is best, let us learn to do so at all cost. It will not be done in a day, for to do so means a revolution. It means every home an ideal one, every school and church up to the highest standard, and these being so far from perfection, it will take patience, perseverence and years to make a marked showing. If we can agree that it is best physically, mentally and morally, and that it will pay to keep the boy on the farm, and can convince him of the truth of it, we can hope to have some success. A first requisite for success anywhere is energy and good health, and nowhere can we hope to find so good a means of obtaining these as in the country, breathing pure air of heaven, in the sunshine, eating pure, fresh food to be found nowhere else, taking the physical culture that comes from plowing, hoeing, sawing wood, etc. Then the regular habits, absence of worry, the diversity of labor, the comparative freedom from excesses of all kinds, all go to make up conditions that make possible the very highest development of the physical man. I repeat that without it there can be no success. Compare the average farmer boy with the average factory boy, clerk, typewriter, bookkeeper, if you would have proof of this. If we could get statistics of the number of successful men in our cities we would find that almost all of them came from the country. I made this statement to the president of a bank a few days ago with the further one, that the sons of these men were not making men to take their father's places, and he agreed with both statements, and to the latter with evident sadness. Boys, if you would succeed you must have strong bodies, and on the farm is your best place to get them.

The mental.—We have a strong physique, can't we also on the farm best develop a mental equipment that will go hand in hand with this strong body? The very same conditions that make the strong physical, will largely assist in the mental, and the fact that farm work is largely manual, leaves the mind free to exert itself, rather stimulates it to do so, and it will more easily grasp a fact than if it were continually at work. Then consider the time the farmer boy has at his disposal for study; the long winter evenings and the inclement days, if he will improve them, he can become a mine of useful information. He can, in a lifetime, read and know all that is good in our literature and that which pertains to his calling. He can be the best educated of all busy men.

The moral.—With all things else ideal if there is a failure here all is lost. Were we to ask a hundred boys as to their aim in life, but few would give the right one; one would say fame, another fortune, and another happiness, etc. There is but one great aim and that is to be useful. If this were our aim there would be few unsolved problems. Take a good country home, where God is worshiped in deed and truth, where at night all gather round the fireside, where the influence of wife, mother and sisters predominates, there the boy will find his best pleasure in that home. There may be discussed those things that make for the higher life, impressions made that will last through life, and I submit that, even if the home is not what it should be, that in the country the temptations of the city and towns are not so close and constant. The busy streets, where temptations are on every corner; the bar rooms, billiard halls, gambling rooms and other forms of vice are farther, much farther removed from the country than from the town home, and the instances are few where a boy gets entirely away from influences that surround him in the first ten or twelve years of his life, and while in after life he may stagger and even fall, the bed rock of the home training, the strong physique and the mental equipment remain, and oftener than otherwise he will right and come out in the end.

But let us consider the business of farming and its success from a moral standpoint. No other calling can succeed except at some one's expense. The men who get fabulously rich in any other profession or calling do so by some form of extortion, and if they make but a subsistance it is at the expense of their cliental, and often out of their misfortunes. Take the lawyer, and there must be disagreement; a physician, and there must be sickness and death; the banker and the merchant, and there must be want. These professions are all necessary under the present order, and it is not intended to disparage anything, but their gain is some one's loss, and their success cannot bring the same exquisite happiness as if it was disassociated with these things. While it is the physician's pleasure to alleviate suffering and save life, yet to do so he must see and be with suffering, and his heart is often wrung, he must see bitter grief and must often see his helplessness, and here, too, he suffers. The lawyer must stand face to face with a great wrong, and while it is his pleasure to right it, yet he must see it, is touched by it, and I am told that of all men the lawyers have the least confidence in human nature. Nothing like this touches the farmer; if he succeeds he does so by the productiveness of his soil and improving his stock and thereby their value. Suppose some one buys a farm of 100 acres for $1,000, equips it with $500 worth of stock and tools, and that it will produce, say ten bushels of wheat per acre, and year by year he builds up his lands until it is worth $100 per acre, or $10,000, and its equipment to $5,000 he has increased his wealth ten fold; he has made $13,500, and not one dollar has come out of any man's pocket; on the other hand, he has enriched every man that he has touched, the carpenter, who builds his houses and barns; the dealers from whom he buys, and the world is richer thereby. Suppose every farmer in Tennessee could show such a balance sheet, we would be the richest State on the globe, and every man in it who would work would share in the prosperity. You will ask, how about the man who buys his products? This the farmer alone sells in the open markets. His products are priced for him, they go at what they will bring, and no man buys them except at a price that he can make money, and mark this, the farmer must depend upon cheapness of production rather than on high prices for his profits. When the land that formerly brought ten bushels of wheat for certain amount of outlay, is made to bring thirty-five bushels for the same outlay, there is profit that a few cents on a bushel does not affect, and all of this possible. I do not forget that I am dealing with the moral question, and trying to show how that a boy may get rich at farming and at the same time meet his high aim and be useful, and he cannot do it in so great a degree anywhere else, and this also answers the question, Will it pay financially to keep the boy on the farm? I say, and I say it reverently, that the conscientious, intelligent farmer, is next to God a creator and co-worker with God in the upbuilding and uplifting of this world.

Will it pay to keep the boys on the farm, and I shall use "pay" in its broader sense. The most independent man alive today is the farmer, and no man can be at his best until he comes to know that upon no man but himself is he to depend for success. You may surround the farmer with a wall so high and strong that no man can scale or break it and he can live out his days without physical want. Let every man's face be turned against him, and he can still have food and raiment in abundance, and that is all the physical comfort that the richest have. Compared with every other calling, the farmer stands alone here, and this fact, if properly appreciated, would make a boy decide for this best of professions. What can even the President of the United States hope for unless the people choose to uphold him? Even within his own party he is powerless, unless the legislative branch of the Government agree with his politics, and so all along down the line of statesmanship and politics, they are absolutely dependent upon a capricous public, and so of all the professions and callings. The lawyer, the doctor, the merchant and bookkeepers and clerks, the manufacturer, the mechanic, all—all must look somewhere for business, and the moment you enter the commercial world you are unavoidably thrown into the irrepressible conflict between labor and capital, the employer and the employed, and the conflicts necessarily brings loss to all concerned, and often ruin and the loss of life itself. To me, this is a very serious phase of the case.

Most of the boys who will be reached by this paper would, if they left home, go out as hirelings, and I do not mean to be offensive here, but it is the truth. You must at the beginning accept menial places where the pay will barely support you, and you will, in a large majority of cases, be in the hands and under the care of those who have and will take no interest in you, except to coin your labor into cash, and usually the boy comes to take just as little interest in the affairs of his employer, and then there is a boy ruined. There are exceptions to these statements, but just enough to make them the rule. You will be called upon to take such treatment as your employer chooses to give, often unmerited abuse, and even if correction be necessary, it will be given in a way that one must sacrifice his manhood if he allows it, and he must allow it or give up his place, and there the boy is put to a new disadvantage, that of losing his place. There are boys who leave the farm and succeed, but for every one who does you will find large numbers who fail, and so I conclude you had better keep your boys on the farm for the sake of society, the farm and the boy.

How, then, shall it be done? If every father was or could be brought to what he should be, and could be depended upon to fill his place as the head of the household, we might rest the entire responsibility upon him, but alas! it is here that the trouble originates. I could name a number of fathers who know how to raise a calf, a colt, a good crop, and do it, but are utter failures in raising boys. The first of all I would ask the father to intelligently examine himself and his method, and begin now to make the rearing of his children the business of his life. To go into details as to how to do this would make this too long, but he must inform himself and then live according to knowledge. The first responsibility rests with the parents, but we must help those who have poor "papas," as George Stewart would say; there should be a wider interest taken in our boys by the best men and women. There must be sacrifices of time and thought in the interest of the boys in your community. Those of you who know what is for a boy's best interest must be willing to patiently work to bring the boys to see it as you do.

See that they use every possible opportunity to inform themselves; get them to the county institutes; to the farmers' convention; to the short courses as given by the University of Tennessee, and if possible, to take a full course in agriculture here. They must be educated, and beyond books. Taking our present conditions, I would, first of all, build first-class roads, accessible to every hamlet in the State, then I would build first-class pubic school houses, say not less than six miles apart, and I would pay salaries that would induce first-class men to prepare themselves for teachers, and every one of them should know the science of agriculture and teach it; and if possible, I would have a miniature experiment station at every school house, and I would have these schools open nine months in the year, and compel attendance, and if there were those who were too poor to properly clothe themselves and furnish books, I would have them fitted out and make a way for them to pay for them. Impractical, you say? Cost too much? Where is the money to come from? Well, first, I would turn our enormous mud tax into this channel; then I would tax every man, woman and child that attends the spring festival, goes on Sunday excursions and to the circuses, theaters, etc., an amount equal to that which they spend for these things, and I would tax every man 50 cents per day for every day he loafs in town, attending court or anywhere else, except for needed rest; and I would make the man who drinks drop a dime in the slot every time he spends one for whisky, and I would have money enough to meet every demand made upon us for making men of our boys.

Gentlemen, we may well be encouraged, the signs of the times point to a better day. This convention is making epochs in the lives of some of our people and is arousing an interest and giving lessons that will win and are telling mightily for good. Our State Department of Agriculture is today far in advance of anything I have known in its efforts and success in advancing the cause for which it stands, and I would give all honor to Commissioner Ogilvie and his co-workers for their intelligent zeal in this behalf. The University of Tennessee, with its course in agriculture, its short course, its practical demonstrations, its active interest stands as the greatest single factor for good in the State, and while I would prefer not to say it in this presence, but simple justice gives me authority to do so, Andrew M. Soule is absolutely filling his place at the head of this great work.

Think of this fair land of ours, with a web of turnpikes in all her borders, and hard by, beautiful and well-kept school houses wherever needed, with every farm showing intelligent, and I may say, loving care, and of every home well kept with flowers and blue grass in the yards and the best books and papers on the table to read, and the Book of books heading the list of the father, the priest of God, and the ruler in his household, his wife and mother, his helpmeet indeed and in truth, of the children, like tender plants growing up in this fertile soil into noble men and women, fearing nothing but God and to do wrong, and you have a result that might be attained. To this end I am content to labor.

PRESERVATION OF SOIL.

By Geo. S. Boyd, of Weakley County.

THE farmer lives close to nature, and is surrounded by its phenomena about which he usually knows but little, and cares less. He plants seed, nurses the resulting plants until they develop into food, which he gathers and eats, yet is totally ignorant of their real nature and inner development. Now, with this ignorance should he remain content?

The entire animal creation, including mankind, is depending on the vegetable kingdom for food with which to sustain life. The farmer's art is to select from the plants that will thrive under the climate where he lives those that are best suited to his wants, and grow them in a way that will produce the greatest results with the least expenditure of labor, and his first starting point is a fertile soil. What is a fertile soil? It is one that contains in it, and around it, all the conditions that are essential to plant life. The sunshine, the atmosphere, the proper amount of moisture or water, and in an available form, all the elements that are necessary to build up the structure of the plant. In an exhausted or barren soil some of these conditions or elements are wanting. In one that has been barren from the beginning of time, or rather was left so by the Creator when this world was formed, it is sometimes difficult to tell what should be done to it to render it fertile and productive; and it is not a safe plan to try and succeed where the Creator has failed. Yet there are exceptions, even to this rule. But with a soil that was once fertile—one that has grown remunerative crops in the past, but has become impoverished by the use and abuse of man, you can enter upon the task of restoring its fertility with every assurance of success. Before analyzing the properties and conditions of a fertile soil it is desirable to know something of the plants themselves. To know how they feed and how they grow. Plants do not all grow under the same conditions. A soil that is best suited to one plant is not necessarily suited to another. The bark of a tree or the surface of a barren rock are suitable places to grow moss and lichens, but they would be poor soil on which to plant a crop of corn, and a soil that would bring a crop of corn to its greatest perfection would not be suited for growing mushrooms. Yet they are all composed of practically the same elements and approximately in the same proportion, and are all used as food for both man and beast. It is well to bear in mind that the principles of evolution play a conspicuous part in the development of plants. The battle for life, the struggle for existence, the warfare that goes on between the different members for the survival of the fittest, is as stubbornly fought out in vegatable as it is in the animal kingdom. But few blades of grass are ever fortunate enough to grow where they would like to grow, and under conditions that are best suited to their wants—they grow where other plants and other blades of grass will let them grow. Yet how do they grow and how do they feed? They feed on the food that is placed at their disposal and grow by means of organs. Their roots are their mouths, their leaves are their lungs. All the food that is consumed by plants, with the exception of carbonic acid, is carried into them through the pores of their roots. Before any element, or compound of elements, can be taken in by the plant it has to be brought to the liquid state, or enter as a solution. The solid or mineral element, those that make up the ashes of the plant, have to enter it in this way. The mineral elements that are too coarse to be dissolved by water are never available as plant food until they are broken down into particles sufficiently small to be taken up by water and held in solution. When this solution enters the plant the elements necessary for its growth are separated and fixed as a part of its own structure. The surplus water is evaporated from the surface of the leaf into the atmosphere in the form of watery vapor. When this water leaves the plant more water is drawn into it through the roots, bringing with it more food; so the more water the leaves evaporate and the more nutritious the food brought in the more rapid will be the growth and development of the plant. It can readily be seen that one indispensable condition of plant life is to have at all times sufficient water to convert its food into a liquid; and one of the essentials of a fertile soil is to be able to supply this water as needed. In order to understand how a fertile soil is able to do this it is necessary to know the relations that exist between the soil and the water. The water exists in the soil in three conditions, viz., hydrostatic, capillary and hydroscopic; for the purpose of this article the capillary and hydroscopic water can be treated as one, and is the water that exists in the soil at all times, the soil is never free from it, it is held there by capillary attraction just as water is held in the pores of a sponge. The hydrostatic water is the surplus that covers the surface of the ground during a rainfall and soon thereafter, but it rapidly passes off to the streams and rivers beyond, or sinks through the pores of the earth to what is known as bottom water, or that which is familiar to us as the water of our wells. When this bottom water sinks to only a few inches or few feet beneath the surface of the earth it produces a marsh or bog, and the soil is unsuited for cultivation; but when it sinks to a depth of five, ten or fifteen feet and has above it a subsoil with proper capillary powers, it is an inexhaustible source of water for supplying the requisite amount needed for the growth of the plants that grow upon the surface of the earth above it. When the water that is near the surface evaporates into the air this bottom water rises to take its place, and is drawn up by the power of capillarity just as the oil of the lamp is drawn through the pores of the wick to feed the flame above. Notwithstanding the benficial effect of rain yet when a maximum crop is grown in an ordinary season it draws the greater part of the moisture necessary for its growth from this capillary water.

On hills and upland soils overlying a sandy or gravelly subsoil in which this capillary connection between the subsurface and the bottom water is broken, maximum crops cannot be grown, except in unusually wet seasons, no matter how much plant food surround the root of the plant, for without water to render this food solvent the plant has to close its pores, droop and wilt until the rains fall again, while crops on the valley and lowland near by are growing and developing by the use of water drawn from below.

Now, as to the elements that go to make up the structure of plants what can be said of them? This earth is composed of sixty-six or more different elements, or different kinds of matter. Forty-nine or fifty of them are metals, the other are nonmetals. As a different classification, five of them are gases, two are liquids and the remainder of them solids, in their elementary state at ordinary temperature; but all the solids can be changed into gases by the application of sufficient heat.

In ordinary life we commonly encounter but twelve of these elements in their elementary state; these, mixed with about a dozen others, make up the great bulk of the things that are familiar to us in this life. By far the greater number of these elements are known only to the chemist. In the field of organic life, that with which the farmer has to deal, four of these elements make up the great bulk of all organic substances. They are oxygen, hydrogen, nitrogen and carbon. These four elements, with a small trace of sulphur and phosphorus, make up all of the volatile parts of plants, or that part which escape into the atmosphere as smoke or vapor when the plant is consumed by fire. When a plant is thus consumed, there remains behind in the form of ashes from one to five percent of the living weight of the plant. This is the part of the plant that is supplied by the earth, or the mineral elements of disintegrated rock, and is made up of eight or ten different elements that are usually found in fertile soils in sufficient quality to supply the wants of plants. Were the soils of the earth composed of these elements in the same proportion in which they are used by plants, and a heavy crop of hay, which removes more of these elements than any other crop, be taken from the soil each year, it would take ten thousand years to exhaust these elements to a depth of twelve inches, to say nothing of those that remain in the subsoil beneath. But they do not exist in the soil in this proportion. In fact, the greater part of all soils is made up of elements of but little use as food for plants. It is not only the elements that exist near the surface of the earth that are available as plant food, for any soil that has the proper capillary construction in its subsoil the available elements, or those that are solvable, are brought from below by the water as it rises to supply the loss from evaporation on the surface, and these elements are left near the surface or are used as plant food as they rise with the water. On a soil above a defective subsoil plants are restricted to the mineral elements that exist near the surface, for on such a soil water cannot bring within the reach of plants the elements from below. Phosphorus is usually the first of these elements to show signs of exhaustion, and potassium the next. When this occurs they must be supplied with fertilizers containing them, or put the land to permanent pasture and await a chemical change in the soil that will render available the elements that have been locked up in particles of the earth too large and hard to be dissolved by water. In the length of time the lands of this country have been under cultivation, it is not probable that any of the mineral elements have been exhausted to the extent that they need replenishing on a soil that has once developed a heavy growth of forest trees; for a growth of such trees is a living evidence of a fertile soil beneath their foliage. When such soils show signs of exhaustion it is due to other causes than the loss of mineral elements.

The four elements that form the volatile part of plants demand a more thorough and specific consideration. Oxygen is a gas in its elementary state, it exists in this condition in the atmosphere, one-fifth of which is oxygen. It is this element that sustains human and animal life by being inhaled by them. It is the most abundant element known to man. It forms one-fifth of the air, eight-ninths of the water and about one-third of the solid crust of the earth. Usually about forty-five per cent of the weight of plants is made up of this element.

Hydrogen, another of the organic elements, is a gas in its elementary state. It is rarely met with in this state, for it has such strong affinity for oxygen that the two readily combine and form water when they are brought together. Water is eight-ninths oxygen and one-ninth hydrogen. The ocean is the great storehouse that contains the hydrogen. Usually about five per cent of the weight of plants is of this element.

Nitrogen, a third one of the organic elements, is also a gas in its elementary state. It exists as such in the atmosphere, four-fifths of which is pure nitrogen. This element supplies from one to five per cent of the weight of plants. Carbon, the fourth of these organic elements, is a solid in all of its allotropic forms. It is the hardest substance known to man. As a crystal it forms the diamond. It exists as an organic product in the charcoal, and as a mineral it is a graphic or lampblack of commerce.

It is the element that is mixed with iron to harden it into steel; and is one that gives strength, solidity and shape of outline to all plants, where it supplies usually about forty-five per cent of their weight. Notwithstanding the fact that it is a solid and the hardest substance known, yet, when it combines chemically with oxygen it becomes a gas. Two atoms of oxygen combined with one atom of carbon to form a molecule of carbonic acid. A small amount of this gas is found in the atmosphere from which plants get the carbon necessary for their growth.

It is estimated that in ten thousand parts of the atmosphere there are from four to six parts of carbonic acid; yet this amount is sufficient to furnish the carbon needed by all of the vegetation that grows upon the surface of the earth. The leaves of the plant inhale carbonic acid from the air, and with the assistance of the sunlight, they break down the chemical affinity that exists between the oxygen and the carbon—they exhale the oxygen and use the carbon for building up the structure of the plant. While oxygen is needed for the growth of plants, they use but little of that which is combined with carbon, but exhale it and utilize the oxygen that is combined with hydrogen in water. So the water not only acts as the vehicle for conveying the food into the plant through the pores of their roots, but when in the plant it furnishes nearly half of the substance necessary for its growth. Ninety to ninety-five per cent of the weight of plants is of these three elements—oxygen, hydrogen and carbon—which are more familiar to us under the names of water and charcoal. These elements not only constitute the bulk of all plants but the organic compounds that the plants furnish as food to sustain man and beast are of these elements. Starch, sugar, all the oils, alcohol and an unlimited number of others are only charcoal and water mixed together by the rays of the sun. Essential as these elements are to plant, they are of but little concern to the farmer; for he does not have to supply them to the plant—nature does this for him—when a plant grows in the open atmosphere it has no trouble supplying itself with all the carbon it needs, and when sufficient water is furnished to render solvent its other food is has more than enough to supply the oxygen and hydrogen. Still, there is another of the organic elements, nitrogen. This element is of more concern to the farmer than all the other elements combined and gives him more trouble. Usually from one to five per cent of the weight of the plant is of this element, but this small amount is as essential to it as either carbon or oxygen, which furnishes so large a part of the substance necessary for its growth. When the supply of nitrogen is not equal to the plant's demands it is either retarded in growth or it perishes. Only think of it! A field of corn growing in an ocean of atmosphere, four-fifths of which is pure nitrogen, its blades shoving the atoms of nitrogen out of their way as they bend to every breeze that passes by, yet starving to death for a small pittance of this element on which to live. Why does such a paradoxical condition exist? It is due to the peculiar chemical properties of this element, which are negative in their nature. Its tendency is to separate itself from other elements when it exists in combination with them, making very unstable compounds. Substances with any great part of this element in their composition are prone to decay. The majority of the crops grown by farmers are unable to assimilate this element in its elementary state. They have to utilize compounds that are made up of this and other elements in order to get this one element out of the compound. Nitrogen combined with oxygen forming nitric acid, a small trace of which is in the atmosphere and in the soil. It combines with oxygen and potassium to form saltpeter, which exists in the soil in small quantities, and the plant is enabled to get part of its nitrogen from these two compounds, but by far greater the amount that is supplied to plants come from ammonia, which is a compound of nitrogen and hydrogen. Three atoms of hydrogen, one of the gases that forms water, combines with one atom of nitrogen to form one molecule of ammonia, which is a gas that exists in the atmosphere, in the soil and in water. Only a small trace of it is found in the atmosphere, the amount is exceedingly minute, yet it is of considerable importance to plants.

There is a strong attraction between this gas and water. One gallon of water, at ordinary temperature, will take up and hold in solution seven hundred gallons of ammonia. The falling rains wash the atmosphere that is between the clouds and the earth of what ammonia it contains and carries it into the soil where it becomes food for plants. In this natural way slow growing and stunted plants that make but little growth in a single season, such as mosses, linchens and sedges are able to get all of the nitrogen necessary for their growth; but rapid growing plants, such as the cereals and large trees, must have this natural supply supplemented in some way or else they perish. This natural supply is always of importance to them, but it is not sufficient for their full development. This supplementary amount can be supplied by artificial fertilizers containing compounds of nitrogen, but the thrifty farmer should utilize the forces of natrue and plant life to supply it instead of buying fertilizers.

The natural source of this supplementarv supply of nitrogen, or the source from which the rapid growing plants get it, when nature is left to take its course untrammeled by man, is the decaying remains of organic substances. Ammonia is a constant product of decaying plants and animals, and when stable or barnyard manure is used for fertilizing crops its chief value is the ammonia that is evolved from the disintergrating mass of vegetable matter of which the manure is composed. If you have plants ready to take up this ammonia and utilize it for man's benefit, all well and good; if not, the decay goes on and the ammonia escapes into the air after the soil has all it can retain, thus being lost to the farmer if his crops are not in shape to utilize it.

What has been said of barnyard manure is true of all parts of all decaying plants. When land is cleared of a virgin forest its fertility is due to the decaying remains of the leaves, twigs, roots and stumps of the forest trees that were removed. After this soil has been cultivated in crops requiring clean culture until all the roots and other remains of the forest have decayed the land is impoverished, and refuses to produce remunerative crops because the soil contains only the mineral elements of the disintergrated rocks from which the soil was built up and the natural supply of nitrogen which is not sufficient to produce a maximum crop. It is true the leaves, stalks and roots of such crops as cotton, tobacco, corn and other of the cereals furnish some ammonia when they decay, but not as much as was exhausted by their growth, so each succeeding crop finds less and less at its disposal until the amount is too small to produce a remunerative crop. What can then be done to restore the soil's fertility? The loss can be supplied by manures or artificial fertilizers; but the more economical way is to restore it with members of the family of plants known as Legumes, such as clover, peas, beans, vetch lucern, etc. Every member of this family has the power of combining or utilizing the free nitrogen of the air, and they leave in the soil more ammonia than was in it before the crop was planted. So a systematic rotation of crops should be adopted, and one including in it a free use of this family in order to keep up the available supply of nitrogen. To recapitulate—it is impossible to grow maximum crops sucessively on a soil deficient in potassium and phosphorus, two of the mineral elements of the ashes of plants, no matter how perfect the physical condition of the soil and the amount of the other plant food at hand. With these present in sufficient quantity you cannot grow cereals, tobacco, cotton and other non-leguminous plants without sufficient decaying organic matter to supply nitrogen in excess of the natural supply. With all of the elements of food in abundance, maximum crops cannot be grown on soil with defective physical conditions, or those that overlie a subsoil with defective capillary properties. The best evidence that all of these conditions exist in a soil is the presence of a heavy growth of forest trees; or if the forest has been removed, the presence of rank and rapid growing weeds. These evidences point to the valley and bottom lands as being the most productive; and experience has proven they are, except in bottoms where you cannot get rid of the excess of water.

Bottom land, where the surplus water has been put under control are the most productive and profitable in the world. Such lands should never be neglected when the cost of reclaiming them is within the bounds of reason.

To outline and fully elucidate the principle on which this can be done requires more space than can be given it here, but the subject is of too much importance to be entirely ignored. Branch and creek bottom lands that are subject to periodic inundations, are rapidly impoverished by the flowing water that passes over the surface where it has been under cultivation. Flowing or running water is capable of taking up and holding in solution a great quantity of mineral and organic matter which it has to deposit as a precipitate when the water ceases to flow. While the bottom is covered with trees, bushes, weeds and grasses, the water is unable to rob it of any great part of its fertility; but when the ground is cleared of vegetation and pulverized by the plow the cohesion and adhesion of the particles of the soil are broken down, and the flowing water readily takes up the solvent part of the soil and carries it off, and this solvent part is that which is available as plant food, what is left behind is usually unavailable. This soil-robbing process can be avoided by a system of dykes or levees arranged to confine the current to the channel of the stream, and force the surplus water to eddy and back over the soil instead of passing over it as a current. When this backwater covers the soil it is unable to hold in solution the alluvium it held while flowing, so it deposits it as a precipitate which enriches the soil instead of impoverishing it. This principle is thoroughly understood and utilized by the Egyptians, who look upon the annual inundation of the River Nile as a blessing instead of a curse.

More attention should be given by farmers to adjusting their crops to suit the soil, instead of trying to force the soil to grow crops for which they are not suited. To illustrate, soils with but little organic matter in them should not be planted with any of the cereals, for they cannot sustain such crops. Soils with an abundance of it should not be planted with legumes, for they are suited to the cereals and other crops requiring clean culture.

Fields with stiff clay subsoils should not be sown with alfalfa, for the roots cannot penetrate it to the bottom water, without which it cannot thrive. Alfalfa should be sown on land with a subsoil sufficiently porous to allow the roots to penetrate to the water. Clover, peas and other legumes must be the main reliance for restoring worn soils, for in no other way can the nitrogen be so economically supplied to plants.

Yet, after all, no formula can be given for reclaiming and managing soils. A formula that would suit one soil would not suit another under the same or different conditions. The best that can be done is to learn the fundamental truths that underlie fertile soils and their relations to plant life, and apply them to the conditions in hand. In enunciating these principles the only facts that can be given here are those that will act as a nucleus around which the farmer can crystalize other and more extended information, as his time, inclination and conditions will allow. Yet there is no cause for his holding with those pessimists who contend that the soil is all being destroyed and washed away, for in the great economy of the universe nothing is wasted or destroyed, everything is conserved. The forces of nature are as indestructible as matter itself—the food we eat, the water we drink and the air we breathe have been eaten, drunk and breathed thousands of times before, and the cycle will continue for generations and ages yet to come. It is true, this earth may some day reach the climax of its climatic and physical development, and its ability to sustain vegetable and animal life wane and finally become extinct; but if that time ever comes, it is so far in the distant future that it does not concern us now, for the earth is yet young and full of virility. Not only does each generation that comes upon the earth find itself better prepared than was its predecessor to enjoy the blessings at its disposal, but the earth, in its chemical, physical and climatic development is better prepared to care for it.

This increasing virility of the earth evidently inspired the poet when he wrote these lines:

"Yet I doubt not thro' the ages one increasing purpose runs,
And the thoughts of men are widening with the process of the suns."

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